



**Flood Risk Assessment
- Richmond upon
Thames College
Redevelopment**

Flood Risk Assessment - Richmond upon Thames College Redevelopment

Prepared for

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Flood Risk Assessment - Richmond upon Thames College Redevelopment

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1 INTRODUCTION

1.1 Background

Richmond upon Thames College is situated at National Grid reference TQ 15384 73787 (nearest postal code TW2 7SJ) in Twickenham adjacent to the south side of Chertsey Road, in south west London. It is proposed to redevelop the college building with new college buildings, a secondary school, a school for children with special needs, a Tech Hub, residential buildings and sports ground. The junction between Chertsey Road and Langhorn Drive is also a part of the development. The redevelopment project is known as Richmond Education and Enterprise Campus (REEC) project.

1.2 Scope of work

Cascade Ltd. instructed ESI Ltd. (ESI) in February 2014 to prepare a Flood Risk Assessment (FRA) in support of a planning application for the Site. ESI is an independent environmental consultancy which specialises in hydrogeological and hydrological assessment.

The scope of work included the preparation of the FRA, following the guidance of the National Planning Policy Framework (NPPF) (DCLG, 2012), to satisfy both the Environment Agency and the LPA that all potential flood risks to and from the proposed development have been considered. The site boundary is taken from the illustrative plan SK-160.

The London Borough of Richmond upon Thames (LBRuT) local authority has indicated that a robust assessment of flood risks must be undertaken. The Level 1 Strategic Flood Risk Assessment of LBRuT was consulted. Reference is also made to the LBRuT's Site Allocation Plan (2014) to help inform the results of sequential and exception tests of the Site.

The Environment Agency required in their scoping opinion that the FRA should address all potential sources of flooding from the Site. Wherever possible, all proposed buildings should lie outside the fluvial 1 in 100 year storm event, plus allowance for climate change impact. If this is not possible, flood plain compensation will be required. Where required, the applicant must demonstrate a safe route of access and egress for any building located near or in the fluvial 1 in 100 chance in any year, plus allowance for climate change impact.

1.1 Data sources

The information presented in the report is predominantly based on secondary data analysis associated with both the Site itself and the surrounding land area. The main sources of data are summarised below.

- GroundSure Flood Report, 2014 (Appendix A)
- Site Location Plan (Drawing SK-120) provided by Cascade Ltd (Appendix B);
- Illustrative Masterplan (Drawing SK-160) provided by Cascade Ltd (Appendix B);
- Site Building Zones Parameter Plan (Drawing SK-124) provided by Cascade Ltd (Appendix B);
- Topographical Survey (2008) undertaken by 3 Sixty Measures (Appendix B);
- Environment Agency Modelled Flood Levels and Maps (Product 4) (Appendix C);
- Thames Water Sewer Flooding Enquiry (Appendix D)
- Ordnance Survey mapping;
- Site-specific rainfall data from the CEH Flood Estimation Handbook (NERC, 2009);

- British Geological Survey mapping for desk study of geology and ground condition;
- Soil types and permeability data from the National Soil Research Institute (NSRI, 2014).

1.2 Report limitations

It is noted that the findings presented in the report are largely based on information supplied by third parties, therefore no guarantee can be offered as to its validity.

This report excludes consideration of potential hazards arising from any activities within the Site other than normal use and occupancy for the intended land uses. Hazards associated with any other activities have not been assessed and must be subject to a specific risk assessment by the parties responsible for those activities.

1.3 Risk assessment approach

An assessment of flood risk has been undertaken in accordance with the NPPF (DCLG, 2012) and following the technical guidance available in Environment Agency (2014). Flood risk to and from the Site has been assessed and potential mitigation measures have been outlined.

2 SITE DESCRIPTION

2.1 Site setting and surrounding area

The current use of the Site is a built up educational campus, with surrounding residential areas. The college is located between Chertsey Road and Cranford Way. The eastern and western boundary of the college is limited by Marsh Farm Lane and Egerton Road respectively. The College playing field is also part of the development site. The River Crane flows to the south of the playing field.

The REEC campus consists of approximately 9 ha of land. The topography is relatively flat with an average elevation between 8.5 mAOD to the south and 9.0 mAOD to the north (3 Sixty Measurement, 2008).

2.2 Current Development (Baseline Phase)

The northern section is occupied by a sports hall with associated facilities, a grass sports pitch, and a car park in the north east corner. The central section is occupied by a collection of buildings housing the College's academic and workshop facilities. The northern section and the central section are divided by a private road which joins Langhorn Drive and subsequently Chertsey Road which is the main vehicle access route. The College playing fields are bounded to the south by the River Crane, to the north by Cranford Way (a public road), and to the east by private housing (

Figure 2.1)



Figure 2.1 Location Plan

2.3 Proposed Development (Operational Phase)

The northern section will be redeveloped into new college buildings, a secondary school, a school for children with special needs, a Tech Hub, STEM centre and Sports centre. The road junction between Chertsey Road and Langhom Drive will be modified to accommodate increased traffic after redevelopment.

The central section will be redeveloped into a residential area. The College playing fields to the south of Craneford Way will be improved with one all weather and one grass pitch. The illustrative Masterplan for the Site is shown in Appendix B.

2.4 Geology

The underlying geology comprises London Clay (Clay and Silt). The superficial deposits comprise the Kempton Park Gravel Formation (sand and gravel).

2.5 Hydrology

2.5.1 Rainfall

The Standard Average Annual Rainfall (SAAR) at the Site is 602 mm based on data for the period 1961 -1990 (NERC, 2008).

2.5.2 Surface Water Features

The River Thames runs 1 km to the south east of the Site and is the main river the watercourses around the Site feed into. Existing watercourses are shown on the Site location map Figure 2.2. Adjacent to Craneford Way East on the south side, the River Crane runs in a man-made canal from west to east, before joining the River Thames further east at NGR TQ 16669 75383.

The Duke of Northumberland River is located west of the Site and flows from south to north towards the River Thames which is located c. 2 km to the east of the Site. It branches off from the River Crane 500 m south west of the Site and flows under Chertsey Road further downstream. A tributary to the River Crane appears at the ground surface, east of Twickenham stadium to the north east of the Site and flows west to east, to join the River Crane 1 km north east of the Site (Figure 2.2).

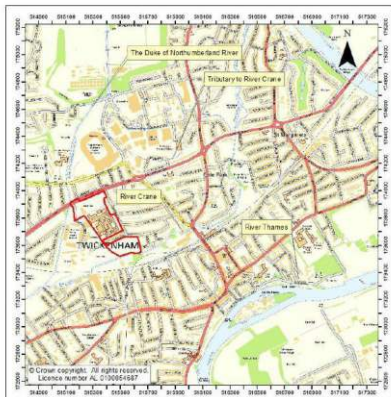


Figure 2.2 Existing Drainage Features

3 FLOOD RISK TO THE DEVELOPMENT SITE (BASELINE PHASE)

3.1 Historical Flooding

The River Thames has a considerable history of flooding with significant events (resulting in property flooding) occurring no less than nine times within the past 100 years (LBRuT, 2010). The most recent River Thames flood occurred in 2003 in which a number of areas to the west of London were severely affected, resulting in damage to homes and businesses within low lying Boroughs (including Spelthorne and Windsor & Maidenhead) along the Thames corridor. The River Crane catchment areas are much smaller than the Thames catchment, and they are subsequently 'flashier' systems that will respond to a rainfall event faster than the River Thames.

The Local Council is aware of localised flooding issues within 1.5 km of the Site at the following locations (LBRuT, 2010):

- Twickenham Bridge

- Twickenham dip

- Back gardens adjacent to the River Crane downstream of Chertsey Road

All of these events occurred further than 500m from the Site and no incidents have been reported on the Site itself. According to Groundsure (2014), no historical flooding has been recorded within 250m of the Site. However, the absence of data does not provide a definitive conclusion that the Site has never flooded, only that the Environment Agency hold no record of any flooding at the Site. Anecdotally, the Community Liaison Forum says that there has been flooding at the Site in the past.

3.2 River and Coastal Flooding

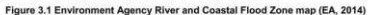
The majority of the Site (including the northern and central section) lies in Flood Zone 1 (Figure 3.1) which has lower than a 1 in 1000 year annual probability of flooding.

The southern half of the College playing field the south of Craneford Way is within Flood Zone 2 which has lower than a 1 in 100 year but higher than a 1 in 1000 year annual probability of flooding.

The SFRA (LBRuT, 2010) indicates that a large proportion of Twickenham, north of the railway line, is within Flood Zone 2 which has between a 1 in 100 and 1 in 1000 year probability of being affected by fluvial flooding from the River Crane and Duke of Northumberland's River.

There is a flood defence comprising a 1.5m high wall and lined channel on the River Crane south of the Site. The design standard of protection of the defence is 1 in 10 year. As the playing field south of Craneford Way is located on a relatively higher ground level to the flood defences, the chance of flooding is estimated to be less than 1 in 100 year based on the EA's flood indicative maps and the River Crane Mapping Study (Halcrow, 2008).

The Duke of Northumberland's River has bank protection on both sides. The design standard of protection is 200 years. The defences along the River Crane and the Duke of Northumberland's River are presented in Figure 3.2.



3.3 Surface Water Flooding

Surface water (pluvial) flooding is usually associated with extreme rainfall events but may also occur when rain falls on land that is already saturated or has a low permeability. In each case, the rainfall generates overland flow which can lead to flooding before the runoff is able to enter a sewer or watercourse. Overland flow can also generate 'ponding' in localised topographical depressions.

The risk of pluvial flooding has been assessed using results from the JBA surface water flooding map (Figure 3.3, taken from GroundSure, 2014) which shows a varied risk of pluvial flooding throughout the Site ranging from negligible to high.

The map shows some areas potentially at risk of surface water ponding for the modelled event. However JBA surface water modelling assumes a symbolic drainage and effectively maps overland flow over topography. JBA mapping is an indication that the risk of surface flooding may exist. A detailed modelling exercise will have to be undertaken to assess the real risk during the detailed design stage. Finished floor levels of REEC should be higher than the modelled surface water flood level.

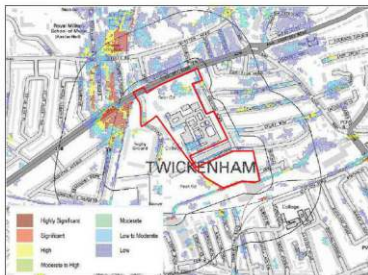


Figure 3.3 Surface Water flood map

The areas associated with the high pluvial flood risk are small and associated with small parts of the grass sports pitch in the northern section. This is believed to be caused by local depressions and locally impermeable soils. The remainder of the Site presents small patches of low to moderate pluvial risk associated with impermeable surfaces and poor drainage.

3.4 Groundwater Flooding

Groundwater flooding occurs when the water table rises above the ground surface. Geological mapping (www.bgs.co.uk) of this Site indicates that the bedrock geology

underlying the Site is the London Clay Formation which is not associated with groundwater flooding and has no aquifer designation. There are superficial deposits of Kempton Park Gravel Formation (sand and gravels) beneath the Site (BGS, 2014) and these are classified as a principal aquifer.

The British Geological Survey (BGS) susceptibility map identifies the Site as having "potential for groundwater flooding at surface" (GroundSure, 2014). However based on a risk assessment the site is considered at negligible risk of groundwater flooding according to the ESI groundwater flood risk map (ESI, 2014), for the 1 in 100 year event based on the map in Figure 3.4. Deep subterranean structures and basements would potentially be at risk of groundwater ingress. In relation to the groundwater flood risk, the ESI map is a National risk map (as used by LandMark) based on modelled groundwater levels and is our selected method for screening the Site. The other reports rely on a susceptibility to groundwater flooding, not risk and are considered to be overly conservative.

The sand and gravels below the Site are most likely in hydraulic continuity with the River Thames. The groundwater response, to a river flood event, could exceed the ground level in the vicinity of the river, even if river bank defences are not overtopped, however the impact is unlikely to extend beneath the main site.



Figure 3.4 Groundwater Flood Risk Map (ESI, 2014)

3.5 Sewer Flooding

The flooding records held by Thames Water indicate that there have been no incidents of flooding in the area as a result of surcharging public sewers (Thames Water, 2014).

3.8 Flooding in the Event of a Reservoir Failure

The Site is not located within an area identified as being at risk of flooding due to the event of a reservoir failure (Groundsure, 2014).

4 FLOOD RISK FROM THE DEVELOPMENT SITE

4.1 Flood Risk during Construction/Demolition Phase

Given the scale of the development, the current expectation is that the development construction programme would commence in 2016 in a phased manner over a 4 year period. For the purposes of the ES, the year of completion and full operation of the development is therefore considered to be 2019. Whilst full details regarding the demolition and construction works are not yet finalised, general information about the likely timing of activities, are described in the Environmental Statement (Cascade, 2015).

Flood risk during construction is likely to differ from the long term condition, as there will be changes in hardstanding on the Site. The construction area of each construction phase and runoff generated is outlined in the drainage assessment report (ESI, 2015). There will be no stockpiling of materials within the identified 100 year return period floodplain during the demolition and construction process.

A strategy to manage the surface water run-off during the construction phase is described in the drainage assessment report (ESI, 2015). Run-off with high loading of suspended solids should be prevented from leaving the Site and entering the surrounding water bodies. This would have a detrimental effect on the local ecology of the water bodies.

Sustainable Drainage System (SuDS) will be required for the development as part of the planning process. It is proposed to install these water management systems at an early stage in the construction process. Care should be taken to protect any SuDS features for long term operation and in particular from being compromised by demolition and construction activities. For example, locations identified for soakaways at conceptual/outline drainage design stage, should not be used as drive ways for lorries during demolition/construction as the loading from the lorries will alter the underlying soil structure and permeability.

In general, it is assumed that works will take place in accordance with standard best practice to prevent impact on water quality associated with any significant rainfall event.

The REEC development scheme will not have plant located below ground or basement or underground parking. Based on the available information at the outline/planning stage, it is reasonable to assume dewatering is not required. At detailed design stage, if the depth of foundation is greater than the maximum groundwater table, dewatering will be required. In that case, a detailed infiltration tests and ground condition is required to undertake estimation of dewatering volume during construction. Provisions should be made to manage this potential issue in line with standard industry practice for construction in saturated ground.

4.2 Flood Risk during Operational Phase

The development of a conceptual site drainage plan at an early stage is required to inform operation of the Site. A sustainable drainage strategy (ESI, 2015) has been developed for operational phase. The proposed drainage scheme assessed the existing drainage of the Site as well as the new SuDS techniques according to the DM SD 7 surface water drainage policy (LBRuT, 2011) and the London Plan. The surface run-off from the proposed development is estimated for return period of 1 in 10 year, 1 in 30 year and 1 in 100 year plus climate change rainfall event. A range of suitable drainage techniques are recommended (green roofs, permeable pavement, soakaways and flood storage area). In the operational phase, the Site is designed to manage surface runoff for a 1 in 100 years plus climate change rainfall event with no discharge to surface watercourses.

A site wide Utility Statement was undertaken by Atkins in May 2014 (Atkins, 2015). The report confirms presence of a soakaway system for draining the current site. The report also suggests a gravity connection to a combined Thames Water manhole MH 5703, serving the eastern portion of the site. However the connections are thought to be blocked and this assumption may need to be verified.

It has therefore been assumed that the current site is successfully drained by soakaway. It is possible that the current soakaways are not adequate to fully drain the Site in extreme rainfall conditions but there is no evidence of flooding occurring on the Site as a consequence, or of informal discharges from the Site into adjacent watercourses during extreme rainfall.

A similar system of soakaways with additional SuDS features should thus be sufficient to attenuate the runoff from the proposed development without a discharge to surface watercourses. Details are described in the sustainable drainage assessment report.

5 SUITABILITY OF THE PROPOSED DEVELOPMENT

5.1 Sequential Tests

Based on the classification of the NPPF, (DCLG, 2012), the proposed development falls into various flood risk vulnerability classifications (Table 2 of NPPF, (DCLG, 2012)). The residential, college and school buildings are classified as more vulnerable infrastructure. The Tech Hub is a less vulnerable and the College playing field is a water compatible infrastructure. The Sequential Test (DCLG, 2014) identifies that development should be directed to areas with the lowest probability of flooding. According to Site Allocation Plan (LBRuT, 2014), the development has passed the sequential test, however this was based on an old Site boundary different from the current one (Figure 5.1) which was solely in Flood Zone 1. The new Site has now been extended to include the College playing fields on Craneford Way East which is within Flood Zone 2. The Site would need to be reconsidered for a sequential test with the current Site boundary. The development on Craneford Way East would consist of outdoor sports and recreation facilities which is 'water compatible development' (Table 2 of NPPF (DCLG, 2014)) so the development is still expected to pass the sequential test.



Figure 5.1 Comparison of the New Site Boundary (Right) with the Old Site Boundary (Left) (LBRuT, 2014)

5.2 Exception Test

Assuming the sequential test is passed the flood risk vulnerability and flood zone 'compatibility' guidance in Table 3 of NPPF (DCLG (2014)) indicates an exception test (see glossary) is not required and the development is considered to be appropriate for this Site (Table 5.1)

Table 5.1 Flood risk vulnerability and flood zone compatibility

| Flood risk vulnerability classification | | Essential infrastructure | Water compatible | Highly vulnerable | More vulnerable | Less vulnerable |
|---|-------------------------------|--------------------------|------------------|-------------------------|-------------------------|-----------------|
| Flood Zone | Zone 1 | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Zone 2 | ✓ | ✓ | Exception Test required | ✓ | ✓ |
| | Zone 3a | Exception Test required | ✓ | x | Exception Test required | ✓ |
| | Zone 3b functional floodplain | Exception Test required | ✓ | x | x | x |

✓ Development is appropriate.

x Development should not be permitted.

Data source: National Planning Policy Framework (NPPF) Technical Guidance, 2014.

6 POTENTIAL MITIGATION

The flood mitigation measures would be considered for REEC for different phases as presented in Table 6.1 (baseline, construction and operation).

6.1 Safe Access and Egress

The Environment Agency states in their scoping opinion that wherever possible, all proposed buildings should lie outside the fluvial 1 in 100 year storm event, plus allowance for climate change flood extent. If this is not possible, flood plain compensation and demonstration of a safe route of access and egress will be required.

All the proposed buildings are located outside the 1 in 100 year plus climate change flood extent as discussed in section 3.6. The College playing field lies in Flood Zone 2. Since the site is not located and surrounded by the 1 in 100 year plus climate change flood extent, a flood plain compensation and safe route of access and egress plan is not required.

Though the College playing field lies in Flood Zone 2, it is considered a water compatible structure and will provide flood storage to attenuate excess runoff (ESI, 2015). Therefore it may provide additional flood storage benefit.

Table 6.1 Potential Receptors, Impact and Flood Mitigation Measures

| Potential Sensitive Receptors | Potential Impact | Potential Effect | | Potential Mitigation Measures |
|--|---|---|---|--|
| | | Scoped In (requires further consideration) | Scoped Out (requires no further consideration) | |
| Rivers and ecology | Silty water (all phases) | ✓ | | SuDS features. |
| Basement/underground structures | Groundwater flooding (all phases) | | ✓ | N/A |
| Playing fields | Fluvial flooding (all phases) | ✓ | | No mitigation is required. |
| Entire Site | Sewer flooding | ✓ | | Extensive usage of SuDS to reduce future potential. |
| Entire Site | Reservoir flooding | | ✓ | N/A |
| Entire Site | Surface water flooding | ✓ | | Appropriate landscaping and use of SuDS |
| Off-site receptors | Flood risk from the proposed development | ✓ | | Design and implementation of a comprehensive SuDS drainage strategy. |
| Chertsey Road Junction (site entrance) | Fluvial flooding | | ✓ | N/A |
| Future operational soakaways SuDS components | Reduce soil infiltration capacity (construction and demolition) | ✓ | | Make sure heavy machinery is directed away from such receptors. |
| Site drainage and SuDS | Silty water (all phases) | ✓ | | Protect the SuDS from sedimentation. |

7 CONCLUSION

It is proposed to re-develop Richmond College in London to a new college building, a secondary school, a school for children with special needs, a Tech Hub and sports grounds, with enabling residential development. The junction connecting Chertsey Road and Langhorn Drive is also a part of the new development. The Site area is c. 9 ha and is currently used for educational purposes.

The majority of the Site, and the area where all new buildings will be located, lies in Flood Zone 1 which has less than 1 in 1000 year annual probability of flooding. A part of the College playing field to the south of the Site lies in Flood Zone 2 which has annual probability of flooding between 1 in 1000 and 1 in 100 year.

The site benefits from flood defences. There are formal defences on both bank of River Crane and The Duke of Northumberland's River.

The River Thames flows approximately 1 km to the south of the Site and it has a considerable history of flooding with significant events (resulting in property flooding) in 2003. However no historical flooding has been recorded within 250m of the Site.

The Site has low to high risk of surface water flooding in different areas according to the JBA surface water flooding map. Groundwater flood risk is negligible at the Site according to the ESI groundwater flood risk map.

Reference is made to the LBRuT's Site Allocation Plan (2014) to help inform the results of sequential and exception tests of the Site. The northern section of the proposed site has passed the sequential test as a part of LBRuT's Site Allocation Plan. The College playing field to the south of the development is a water compatible land use according to the NPPF (DCLG, 2014). Therefore no exception test would be required and the development is appropriate for this location, provided suitable mitigation measures are in place.

Flood risk to the potential receptors and suitable mitigation measures have been assessed. The flood risk from the proposed development during construction/demolition and operational phase has been assessed in a separate sustainable drainage assessment report (ESI, 2015). The report also presents surface runoff produced during a 1 in 100 year plus climate change event and drainage strategy to manage and attenuate the excess runoff without discharging to surface watercourses.

The Environment Agency's comments during scoping opinion have been addressed in the FRA. All proposed buildings lie outside the fluvial 1 in 100 year storm event, plus allowance for climate change impact. Therefore no flood plain compensation will be required and the requirement of a safe route of access and egress is not necessary for the proposed Site.

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3 Sixty Measurement, 2008 Underground Service Survey report

APPENDICES

APPENDIX A

Groundsure flood report

| | |
|-------------------------|------------------------------|
| Report Reference: | CMAPS-CM-325206-28958-150514 |
| Your Reference: | 28958 |
| Report Date: | 15 May 2014 |
| Report Delivery Method: | Email - pdf |
| Client Email: | andy@centremaps.com |

GroundSure Floodview

Address: RICHMOND-UPON-THAMES COLLEGE, EGERTON ROAD, ST MARGARETS AND NORTH TWICKENHAM, TWICKENHAM, TW2 7SJ

Dear Sir/Madam,

Thank you for placing your order with CENTREMAPS. Please find enclosed the GroundSure Floodview report as requested.

If you need any further assistance, please do not hesitate to contact our helpline on 01886 832972 quoting the above CENTREMAPS reference number.

Yours faithfully,

CENTREMAPS

Enc.
GroundSure Floodview

Report Reference: CMAPS-CM-325206-28958-150514

GroundSure Floodview

Address: RICHMOND-UPON-THAMES COLLEGE, EGERTON ROAD, ST MARGARETS AND NORTH
TWICKENHAM, TWICKENHAM, TW2 7SJ

Date: 15 May 2014

Your Reference: 28958

Client: CENTREMAPS



Aerial Photograph of Study Site



Site Name: RICHMOND-UPON-THAMES COLLEGE, EGERTON ROAD, ST MARGARETS AND NORTH TWICKENHAM, TWICKENHAM, TW2 7SJ

Grid Reference: 515351, 173703

Size of Site: 19.42 ha

Aerial photography supplied by GeoMapping PLC,
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Page 3

Executive Summary: Flood Risk

The following opinion is provided by GroundSure on the basis of the information available at the time of writing and contained within this report.



| | |
|---|----------------------|
| Is insurance cover for flooding likely to be available for the property based upon Environment Agency NaFRA data? | May not be available |
| What is the highest NaFRA risk rating for the property? | High |
| What is the highest Environment Agency Flood Zone risk at the property? | High |
| What is the risk of flooding from pluvial/surface water sources? | Significant |
| If the site were to be redeveloped, would a NPPF flood risk assessment be required? | Yes |

Recommendations

It is recommended that several insurers are contacted to confirm the availability of reasonably priced insurance for the property.

The purchaser may wish to make specific enquiries of the vendor regarding the history of flooding at the property.

National Flood Risk Assessment (NaFRA)

As the site lies within or in close proximity to an area with a High risk rating in the NaFRA database, a prudent purchaser may wish to consider reducing the impact of flooding at the property by installing flood protection measures. Such measures may help reduce the effects of flooding at the property if flood defences are absent or are breached, and may assist in obtaining insurance for the site. Furthermore, it is recommended that anyone living within an

area at High risk signs up to the Environment Agency's Flood Warning Scheme on 0845 988 1188 or at www.environment-agency.gov.uk.

Environment Agency Flood Zones

The site has been identified to lie within Flood Zone 3 as designated by the Environment Agency, indicating the site has a predicted chance of flooding of greater than 1.0% from fluvial sources or greater than 0.5% from coastal sources in any given year.

It is recommended that a purchaser consider reducing the impact of flooding at the property by installing flood protection measures. Such measures may help reduce the effects of flooding at the property if flood defences are absent or are breached, and may assist in obtaining insurance for the site. Further information on flood protection measures may be obtained from the National Flood Forum or the Flood Protection Association.

Groundwater Flooding

The BGS have identified potential for groundwater flooding at surface level in the area. This means that given the geological conditions in the vicinity groundwater flooding hazard should be considered in all land-use planning decisions. It is recommended that other relevant information e.g. records of previous incidence of groundwater flooding, rainfall, property type, and land drainage information be investigated in order to establish relative, but not absolute, risk of groundwater flooding.

Development Guidance

If the site is to be developed, a detailed Flood Risk Assessment will be required. 'Highly Vulnerable' developments, as defined within the National Planning Policy Framework (NPPF), will not be permitted within a Zone 3 floodplain, and 'Essential Infrastructure' and 'More Vulnerable' developments will be required to pass an Exemption Test prior to permission being granted. A GroundSure Flooding Desktop Report would assist in clarifying the flood risk to the property and assessing the potential for development at the site in relation to flood risk. GroundSure Flooding Desktop Reports are available from £500 + VAT. Please contact GroundSure for further details.

JBA Surface Water (Pluvial) Flooding

As the site lies within an area considered to be at Significant risk of surface water flooding (with a predicted depth of flooding of between 0.3m and 1m in a 1 in 75 year flooding event), it is recommended that a purchaser obtains a more detailed flood risk assessment. Some insurers may choose to not provide insurance cover for properties with a Significant risk of surface water flooding. The detailed flood risk assessment will further quantify the risk of flooding at the site as well as examining the history of flooding at the site, reviewing the standard of protection afforded to the site and providing a quote for a Full Flood Risk Assessment to meet the requirements of NPPF, if required. A GroundSure Flooding Desktop Report is available from GroundSure from £500 + VAT. Please contact GroundSure for further details.

Alternatively, a purchaser may wish to consider reducing the impact of flooding at the property by installing flood protection measures at the site. Such measures may help reduce the effects of flooding at the property if flood defences are absent or are breached, and may assist in obtaining insurance for the site. Further information on flood protection measures may be obtained from the National Flood Forum or the Flood Protection Association.

Historic Flood Events

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The site is not recorded to have been subject to historic flooding. However, the absence of data does not provide a definitive conclusion that the site has never flooded, only that the Environment Agency hold no record of any flooding at the site.

Additional Matters

| | |
|--------------------|--|
| Riparian ownership | If your land abuts a river, stream or ditch, you may have responsibility to maintain this watercourse, even if Title Deeds show the property boundary to be adjacent to the watercourse. This includes the responsibility for clearing debris and obstructions which may impede the free passage of water and fish, and also includes the responsibilities to accept flood flows through your land, even if these are caused by inadequate capacity downstream. There is no duty in common law for a landowner to improve the drainage capacity of a watercourse. Please contact GroundSure if you need further advice on riparian ownership issues relating to this property. |
| Sewerage Flooding | Extreme rainfall events may overwhelm sewerage systems and cause local flooding. The water and sewerage companies within the UK are required to maintain 'DG5 - At Risk Registers' which record properties that have flooded from sewers and/or are considered to be at risk of flooding from sewers in the future. If your property is on the 'At Risk' Register, this may be recorded within a standard CON29 Drainage and Water search. |

Overview of Findings

For further details on each dataset, please refer to each individual section in the main report as listed.

Report Section

1. Environment Agency Flood Zones

| | |
|--|-----|
| 1.1 Are there any Environment Agency Zone 2 floodplains within 250m of the study site? | Yes |
| 1.2 Are there any Environment Agency Zone 3 floodplains within 250m of the study site? | Yes |
| 1.3 Are there any Flood Defences within 250m of the study site? | No |
| 1.4 Are there any areas benefiting from Flood Defences within 250m of the study site? | No |
| 1.5 Are there any areas of Proposed Flood Defences within 250m of the study site? | No |
| 1.6 Are there any areas used for Flood Storage within 250m of the study site? | No |

2. National Flood Risk Assessment (NaFRA)

| | |
|---|------|
| 2.1 What is the National Flood Risk Assessment (NaFRA) Flood Rating for the study site? | High |
|---|------|

3. Historic Flood Events

| | |
|---|----|
| 3.1 Has the site been subject to past flooding as recorded by the Environment Agency? | No |
|---|----|

4. Surface Water Floods

| | |
|---|-----|
| 4.1 Is the site or any area within 50m at risk of Surface Water (Pluvial) Flooding? | Yes |
|---|-----|

5. Groundwater Flooding

| | |
|---|---|
| 5.1 What is the maximum BGS Groundwater Flooding susceptibility within 50m of the study site? | Potential for groundwater flooding at surface |
| 5.2 What is the BGS confidence rating for the Groundwater Flooding susceptibility areas? | Moderate |

6. BGS Geological Indicators of historic flooding

| | |
|---|-----|
| 6.1 Are there any geological indicators of historic flooding within 250m of the study site? | Yes |
|---|-----|

7. JBA Reservoir failure

| | |
|---|----|
| 7.1 Is the property located in an area identified as being at potential risk in the event of a reservoir failure? | No |
|---|----|

Using this Report

The following report is designed by Environmental Consultants for commercial property transactions bringing together the most up-to-date market leading environmental data. This report is provided under and subject to the Terms & Conditions agreed between GroundSure and the Client.

Note: Maps

Only certain features are placed on the maps within the report. All features represented on maps found within this search are given an identification number. This number identifies the feature on the mapping and correlates it to the additional information provided below. This identification number precedes all other information and takes the following format -Id: 1, Id: 2, etc. Where numerous features on the same map are in such close proximity that the numbers would obscure each other a letter identifier is used instead to represent the features, (e.g. Three features which overlap may be given the identifier "A" on the map and would be identified separately as features 1A, 3A, 10A on the data tables provided).

Where a feature is reported in the data tables to a distance greater than the map area, it is noted in the data table as "Not Shown".

All distances given in this report are in Metres (m). Directions are given as compass headings such as N: North, E: East, NE: North East from the nearest point of the study site boundary.

Flood Risk Framework

The Flood Risk Assessment section is based on datasets covering a variety of different flooding types. No inspection of the property or of the surrounding area has been undertaken by GroundSure or the data providers. The modelling of flood hazards is extremely complex and in creating a national dataset certain assumptions have been made and all such datasets will have limitations. These datasets should be used to give an indication of relative flood risk rather than a definitive answer. Local actions and minor variations, such as blocked drains or streams etc. can greatly alter the effect of flooding. A low or negligible modelled flood risk does not guarantee that flooding will not occur. Nor will a high risk mean that flooding definitely will occur. GroundSure's overall flood risk assessment takes account of the cumulative risk as assessed within the Environment Agency's NaFRA and Flood Zone datasets, Historic Flood Events and surface water (pluvial) flooding.

This report provides an overall risk ranking of flooding potential at the site as well as answering the following key questions:

Is insurance likely to be available for the property?

A number of insurance companies providing cover for flood risk use this data as the basis of their risk model, although they may also utilise additional information such as claims histories, which may further influence their decision. Where a significant risk of flooding is identified flood risk insurance may be difficult to obtain without further work being undertaken. Property owners of sites within Low and Medium risk areas are still considered to be at risk of flooding and insurance premiums may be increased as a result. Owners of properties within Low, Medium and High risk areas are advised to sign up to the Environment Agency's Flood Warning scheme.

- Very Low – the chance of flooding from rivers or the sea is considered to be Less than 1 in 1000 (0.1%) chance in any given year.
- Low – the chance of flooding from rivers or the sea is considered to be less than 1 in 100 (1%) but greater than or equal to 1 in 1000 (0.1%) chance in any given year.
- Medium – the chance of flooding from rivers or the sea is considered to be less than 1 in 30 (3.3%) but greater than or equal to 1 in 100 (1%) chance in any given year.
- High – the chance of flooding from rivers or the sea is considered to be greater than or equal to 1 in 30 (3.3%) chance in any given year.

What is the Environment Agency NaFRA risk rating for the property?

This rating is based upon the highest NaFRA risk band to be found within the site boundary. See above for an explanation of NaFRA risk banding.

What is the highest Environment Agency Flood Zone risk at the site?

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The Environment Agency estimates the annual probability of flooding from rivers and the sea as:-

- Zone 1 – little or no risk with an annual probability of flooding from rivers and the sea of less than 0.1%.
- Zone 2 – low to medium risk with an annual probability of flooding of 0.1-1.0% from rivers and 0.1-0.5% from the sea.
- Zone 3 (or Zone 3a) – high risk with an annual probability of flooding of 1.0% or greater from rivers, and 0.5% or greater from the sea.
- Zone 3b – very high risk with the site being used as part of the functional flood plain or as a Flood Storage Area.

Where the property is in an area benefiting from flood defences these may be taken into account within the flood risk assessment provided. However it should be noted that flood defences do not entirely remove the risk of flooding, as they can fail or overtop. Owners of properties within Zone 2 and Zone 3 are advised to sign up to the Environment Agency's Flood Warning scheme.

What is the risk of flooding from pluvial/surface water sources?

JBA Risk Management surface water flood map identifies areas likely to flood following extreme rainfall events, i.e. land naturally vulnerable to surface water or "pluvial" flooding. This data set was produced by simulating 1 in 75 year, 1 in 200 year and 1 in 1000 year rainfall events. Modern urban drainage systems are typically built to cope with rainfall events between 1 in 20 and 1 in 30 years, though older ones may even flood in a 1 in 5 year rainstorm event.

The model provides the maximum depth of flooding in each 5m "cell" of topographical mapping coverage. The maps include 7 bands indicating areas of increasing natural vulnerability to surface water flooding. These are:-

- 0.1m or greater in a 1 in 1,000 year rainfall event - Low
- Between 0.1m and 0.3m in a 1 in 200 year rainfall event - Low to Moderate
- Between 0.3m and 1.0m in a 1 in 200 year rainfall event - Moderate
- Greater than 1.0m in a 1 in 200 year rainfall event - Moderate to High
- Between 0.1m and 0.3m in a 1 in 75 year rainfall event - High
- Between 0.3m and 1.0m in a 1 in 75 year rainfall event - Significant
- Greater than 1.0m in a 1 in 75 year rainfall event - Highly Significant

If the site is to be redeveloped, will a Flood Risk Assessment be required under National Planning Policy Framework?

The National Planning Policy Framework identifies the need for Flood Risk Assessments to be carried out for developments within Flood Zones. Furthermore, any development proposals comprising one hectare or above will require a brief Flood Risk Assessment, partly due to their potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of new development on surface water run-off.

The Recommendations will also highlight whether the site has been subject to an historic flood event as recorded by the Environment Agency. Furthermore, the recommendations will indicate whether the site is considered to lie within an area which may be susceptible to groundwater flooding. However, information regarding groundwater flooding susceptibility is not used to calculate the overall flood risk to the property due to the limitations of the database. Additionally, the flood risk assessment does not take account of flooding from sources such as burst water mains, blocked sewers or appliance failure.

1. Environment Agency Flood Map for Planning (from rivers and the sea)

NW

N

NE



SW

S

SE

Environment Agency Flood Map for
Planning Legend



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1000152017.

- | | | |
|--------------------|-------------------|-------------------------------------|
| Search Centre | Zone 2 Floodplain | Area used for Flood Storage |
| Search Buffers (m) | Zone 3 Floodplain | Proposed Flood Defence Scheme |
| | Flood Defences | Area Benefiting from Flood Defences |

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1. Environment Agency Flood Zones

1.1 River and Coastal Zone 2 Flooding

Is the site within 250m of an Environment Agency Zone 2 floodplain?

Yes

Zone 2 floodplain estimates the annual probability of flooding as one in one thousand (0.1%) or greater from rivers and the sea but less than 1% from rivers or 0.5% from the sea. Any relevant data is represented on Map 1 - Flood Map for Planning.

The following floodplain records are represented as green shading on the Flood Map (1):

| ID | Distance [m] | Direction | Update | Type |
|----|--------------|-----------|-------------|---------------------------|
| 1 | 0.0 | On Site | 27-Feb-2014 | Zone 2 - (Fluvial Models) |
| 2 | 0.0 | On Site | 27-Feb-2014 | Zone 2 - (Fluvial Models) |
| 3 | 5.0 | S | 27-Feb-2014 | Zone 2 - (Fluvial Models) |
| 4 | 5.0 | SE | 27-Feb-2014 | Zone 2 - (Fluvial Models) |
| 5 | 8.0 | S | 27-Feb-2014 | Zone 2 - (Fluvial Models) |

1.2 River and Coastal Zone 3 Flooding

Is the site within 250m of an Environment Agency Zone 3 floodplain?

Yes

Zone 3 estimates the annual probability of flooding as one in one hundred (1%) or greater from rivers and a one in two hundred (0.5%) or greater from the sea. Any relevant data is represented on Map 1 - Flood Map for Planning.

The following floodplain records are represented as green shading on the Flood Map (1):

| ID | Distance [m] | Direction | Update | Type |
|----|--------------|-----------|-------------|---------------------------|
| 28 | 0.0 | On Site | 27-Feb-2014 | Zone 3 - (Fluvial Models) |
| 29 | 0.0 | On Site | 27-Feb-2014 | Zone 3 - (Fluvial Models) |
| 30 | 0.0 | On Site | 27-Feb-2014 | Zone 3 - (Fluvial Models) |
| 31 | 0.0 | S | 27-Feb-2014 | Zone 3 - (Fluvial Models) |
| 32 | 24.0 | NW | 27-Feb-2014 | Zone 3 - (Fluvial Models) |
| 33 | 151.0 | S | 27-Feb-2014 | Zone 3 - (Fluvial Models) |
| 34 | 166.0 | NW | 27-Feb-2014 | Zone 3 - (Fluvial Models) |

1.3 River and Coastal Flood Defences

Are there any Flood Defences within 250m of the study site?

No

This search consists only of flood defences present in the dataset provided by the Environment Agency. Any relevant data is represented on Map 1 - Flood Map for Planning.

1.4 Areas benefiting from Flood Defences

Are there any areas benefiting from Flood Defences within 250m of the study site?

No

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Any relevant data is represented on Map 1 – Flood Map for Planning.

1.5 Proposed Flood Defences

Are there any Proposed Flood Defences within 250m of the study site?

No

Guidance: This search consists only of proposed flood defences present in the dataset provided by the Environment Agency. Please note that proposed flood defence schemes will not influence the current NafRA ratings for the site.

Any relevant data is represented on Map 1 – Flood Map for Planning

This information is taken from the Environment Agency's database of Areas to Benefit from New and Reconditioned Flood Defences under the Medium Term Plan (MTP). The dataset contains funding allocation for the first financial year (from April). Funding for the following four financial years is not guaranteed, being only indicative, and will be reviewed annually. Projects within the Medium Term Plan qualify for inclusion in this dataset if:

- the investment leads to a change in the current standard of protection (change projects);
- the investment is a replacement or refurbishment in order to sustain the current standard of protection (sustain projects);
- the project has an initial construction budget of £100,000 or more; and
- the project is included within the first five years of the MTP

The data includes all the Environment Agency's projects over £100K that will change or sustain the standards of flood defence in England and Wales over the next 5 years. It also includes the equivalent schemes for all Local Authority and Internal Drainage Boards. The number of households and areas of land contributing to DEFRA's Outcome Measures (OM) are also attributed i.e. could benefit from major work on flood defences.

These data also contain Intermittent Flood Maintenance Programme that show the annual maintenance programme of work scheduled to be carried by the Environment Agency, Local Authority or Internal Drainage Board on flood defences. Data details routine maintenance as well as intermittent work that has been funded for the coming year. The data contains a start and end coordinate defining the relevant river section where work is planned.

Information Warning

Please note that the maps show the areas where investment is being made to reduce the flood and coastal erosion risk and are not detailed enough to account for individual addresses. Individual properties may not always face the same risk of flooding as the areas that surround them. Also, note that funding figures are indicative and any use or interpretation should account for future updates where annual values may change.

Every possible care is taken to ensure that the maps reflect all the data possessed by the Environment Agency and that they have applied their expert knowledge to create conclusions that are as reliable as possible. The Environment Agency consider that they have created the maps as well as they can and so should not be liable if the maps by their nature are not as accurate as might be desired or are misused or misunderstood, despite their warnings. For this reason, they are not able to promise that the maps will always be accurate or completely up to date.

This site includes mapping data licensed from Ordnance Survey used for setting the Environment Agency's data in its geographical context. Ordnance Survey retains the copyright of this material and it can not be used for any other purpose.

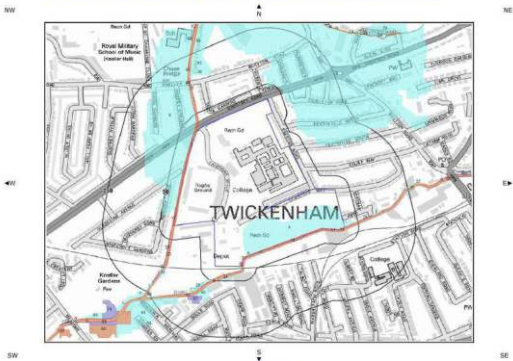
1.6 Areas used for Flood Storage

Are there any areas used for Flood Storage within 250m of the study site?

No

Flood Storage Areas are considered part of the functional floodplain, and are areas where water has to flow or be stored in times of flood. The National Planning Policy Framework states that only water-compatible development and essential infrastructure should be permitted within flood storage areas, and existing development within this area should be relocated to an area with a lower risk of flooding. Any relevant data is represented on Map 1 – Flood Map for Planning.

2. Environment Agency NaFRA Flooding Map



Environment Agency NaFRA Flood Legend



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Site Outline

125 Search Buffers (m)
250

NAFRA Rating

Very Low

Low

Medium

High

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2.1 National Flood Risk Assessment (NaFRA) Flood Rating (River and Coastal)

What is the highest risk of flooding onsite?

High

The Environment Agency NaFRA database provides an indication of river and coastal flood risk at a national level on a 50m grid with the flood rating at the centre of the grid calculated and given above. The data considers the likelihood of flood defences overtopping or breaching by considering their location, type, condition and standard of protection.

A number of insurance companies providing cover for flood risk use this data as the basis of their risk model, although they may also utilise additional information such as claims histories, which may further influence their decision. Where a high risk of flooding is identified flood risk insurance may be difficult to obtain without further work being undertaken. Property owners of sites within Low and Medium risk areas are still considered to be at risk of flooding and insurance premiums may be increased as a result. Owners of properties within Low, Medium and High risk areas are advised to sign up to the Environment Agency's Flood Warning scheme.

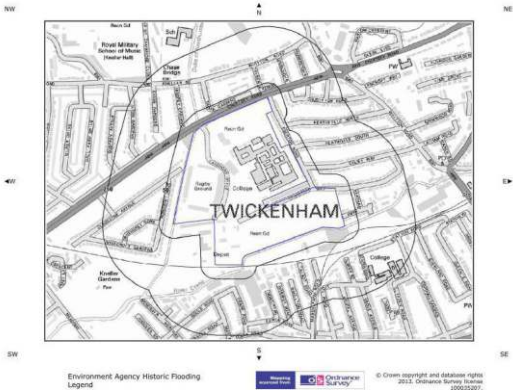
NaFRA data for the study site indicates the property is in an area with a High (1 in 30 or greater) chance of flooding in any given year.

Any relevant data within 250m is represented on Map 2- NaFRA Flooding:

Any data found within 50m of the site boundary is detailed below:

| ID | Distance [m] | Direction | NaFRA flood Risk |
|-----|--------------|-----------|------------------|
| 1 | 0.0 | On Site | High |
| 2 | 0.0 | On Site | Medium |
| 3 | 0.0 | On Site | High |
| 4 | 0.0 | On Site | Low |
| 5A | 0.0 | On Site | Low |
| 6B | 0.0 | On Site | Low |
| 7 | 0.0 | On Site | Low |
| 8 | 2.0 | W | Low |
| 9A | 4.0 | SE | Low |
| 10 | 4.0 | S | Medium |
| 11 | 4.0 | S | Medium |
| 12B | 4.0 | E | Low |
| 13 | 4.0 | W | Medium |
| 14 | 5.0 | SE | Medium |
| 15C | 5.0 | S | Low |
| 16C | 5.0 | S | Low |
| 17 | 8.0 | S | High |
| 18B | 9.0 | SE | Low |
| 19B | 9.0 | S | Low |
| 20 | 11.0 | SW | Medium |
| 21D | 14.0 | S | Low |
| 22D | 24.0 | S | Low |
| 23 | 29.0 | S | Medium |
| 24 | 32.0 | S | Low |
| 25 | 39.0 | S | Low |
| 26 | 45.0 | N | Low |

3. Environment Agency Historic Flooding Events



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3.1 Historic Flood Outlines

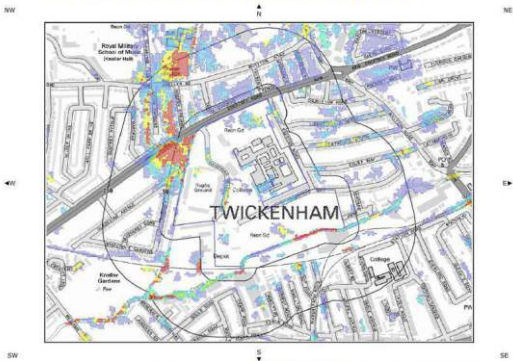
Has the site or any area within 250m of the site been subject to historic flooding as recorded by the Environment Agency? **No**

This database shows the individual footprint of every flood event recorded by the Environment Agency and previous bodies. This data is used to understand where flooding has occurred in the past and provides details as available. Absence of a historic flood event for an area does not mean that the area has never flooded, but only that the Environment Agency do not currently have records of flooding within the area. Equally, a record of a flood footprint in previous years does not mean that an area will flood again, and this information does not take account of flood management schemes and improved flood defences.

Any records found within the search radius are displayed on Map 3 – Historic Flooding Events.

Historic flooding events: Database searched and no data found.

4. JBA Surface Water (Pluvial) Flood Map

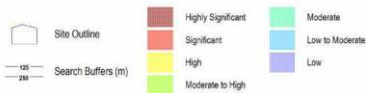


JBA Surface Water (Pluvial) Flood
Legend



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4.JBA Surface (Pluvial) Water Flooding

Surface Water (pluvial) flooding is defined as flooding caused by rainfall-generated overland flow before the runoff enters a watercourse or sewer. In such events, sewerage and drainage systems and surface watercourses may be entirely overwhelmed.

Surface Water (pluvial) flooding will usually be a result of extreme rainfall events, though may also occur when lesser amounts of rain falls on land which has low permeability and/or is already saturated, frozen or developed. In such cases overland flow and "ponding" in topographical depressions may occur.

What is the risk of pluvial flooding at the study site?

Significant

Guidance: The site has been assessed to be at a Significant Risk of surface water (pluvial) flooding. This indicates that this area would be expected to be affected by surface water flooding in a 1 in 75 year rainfall event to a depth of between 0.3m to 1m.

This data is provided by JBA Risk Management, © Jeremy Benn Associates Limited 2008-2014

The following pluvial (surface water) flood risk records within 50m of the study site are shown on the JBA Surface Water Flooding Map:

[illegible]

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[illegible]

| | | |
|------|---------|-----------------|
| 0.0 | On Site | Significant |
| 0.0 | On Site | Significant |
| 0.0 | On Site | Significant |
| 0.0 | On Site | Significant |
| 0.0 | W | Significant |
| 1.0 | S | High |
| 1.0 | S | High |
| 1.0 | W | High |
| 1.0 | S | Low |
| 1.0 | W | Low |
| 1.0 | S | Low to Moderate |
| 1.0 | S | Low to Moderate |
| 1.0 | W | Low to Moderate |
| 1.0 | W | Low to Moderate |
| 1.0 | W | Low to Moderate |
| 2.0 | S | Low |
| 2.0 | S | Low |
| 2.0 | SE | Low |
| 2.0 | S | Low |
| 2.0 | S | Low |
| 2.0 | W | Moderate |
| 3.0 | E | Low |
| 3.0 | S | Low to Moderate |
| 3.0 | W | Significant |
| 4.0 | W | High |
| 4.0 | SE | Low |
| 4.0 | W | Low to Moderate |
| 4.0 | W | Significant |
| 5.0 | S | High |
| 5.0 | S | Low |
| 6.0 | E | High |
| 6.0 | W | Low |
| 6.0 | SE | Low |
| 6.0 | W | Low |
| 6.0 | W | Low to Moderate |
| 6.0 | W | Low to Moderate |
| 7.0 | E | Low to Moderate |
| 8.0 | S | Low |
| 8.0 | W | Low |
| 8.0 | W | Low to Moderate |
| 9.0 | E | Low |
| 10.0 | W | High |
| 10.0 | W | High |
| 10.0 | S | High |
| 10.0 | W | Low to Moderate |
| 10.0 | W | Moderate |
| 10.0 | S | Significant |
| 13.0 | W | High |
| 13.0 | S | Low |
| 13.0 | E | Low |
| 13.0 | W | Low to Moderate |
| 13.0 | W | Moderate |
| 14.0 | W | Low |
| 15.0 | S | Low |
| 15.0 | S | Low to Moderate |
| 16.0 | E | Low to Moderate |
| 16.0 | W | Moderate |
| 16.0 | W | Significant |
| 17.0 | E | Low |
| 17.0 | W | Significant |
| 18.0 | W | Low |
| 18.0 | S | Low |
| 18.0 | W | Low to Moderate |
| 19.0 | W | High |
| 19.0 | SE | Low |
| 19.0 | W | Low to Moderate |
| 20.0 | S | High |
| 20.0 | W | Low |
| 20.0 | S | Low to Moderate |
| 20.0 | W | Significant |
| 20.0 | S | Significant |
| 21.0 | W | High |
| 21.0 | S | Low |
| 22.0 | N | Low |
| 22.0 | S | Low |
| 23.0 | SE | Low to Moderate |
| 23.0 | E | Moderate |
| 24.0 | E | Low |

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| | | |
|------|----|------------------|
| 24.0 | W | Low to Moderate |
| 23.0 | S | Low |
| 23.0 | W | Low to Moderate |
| 25.0 | S | Moderate |
| 26.0 | SE | High |
| 26.0 | W | High |
| 26.0 | NE | Low |
| 26.0 | S | Low |
| 26.0 | W | Low |
| 26.0 | N | Low |
| 26.0 | SE | Low to Moderate |
| 27.0 | E | Low |
| 27.0 | W | Low |
| 27.0 | S | Low to Moderate |
| 28.0 | E | Low to Moderate |
| 28.0 | W | Low to Moderate |
| 29.0 | NW | Low |
| 29.0 | W | Low to Moderate |
| 29.0 | NW | Low to Moderate |
| 29.0 | W | Low to Moderate |
| 30.0 | NW | Low |
| 30.0 | S | Low |
| 30.0 | NW | Low |
| 31.0 | NW | Low |
| 31.0 | NE | Low to Moderate |
| 31.0 | N | Low to Moderate |
| 31.0 | NW | Low to Moderate |
| 32.0 | NW | Low |
| 32.0 | W | Low |
| 32.0 | W | Low |
| 32.0 | NW | Low |
| 32.0 | W | Low |
| 32.0 | W | Low to Moderate |
| 32.0 | N | Moderate |
| 33.0 | W | High |
| 33.0 | W | High |
| 33.0 | NW | Low |
| 33.0 | W | Significant |
| 34.0 | W | Low to Moderate |
| 35.0 | W | Low |
| 35.0 | S | Low |
| 35.0 | S | Low |
| 35.0 | S | Low |
| 35.0 | E | Low |
| 35.0 | S | Low to Moderate |
| 35.0 | S | Moderate |
| 35.0 | W | Significant |
| 36.0 | S | Low |
| 36.0 | NW | Low |
| 36.0 | NW | Low to Moderate |
| 36.0 | NE | Low to Moderate |
| 37.0 | W | High |
| 37.0 | W | Low |
| 37.0 | S | Low |
| 37.0 | W | Moderate |
| 38.0 | E | Low |
| 38.0 | NE | Low |
| 38.0 | E | Low |
| 39.0 | W | High |
| 39.0 | NW | Low |
| 40.0 | NE | Low |
| 40.0 | S | Low |
| 40.0 | W | Low |
| 40.0 | NW | Low |
| 40.0 | S | Moderate |
| 41.0 | W | Low |
| 41.0 | NW | Low |
| 41.0 | NE | Low |
| 43.0 | NW | Low to Moderate |
| 43.0 | NW | Moderate |
| 44.0 | NW | High |
| 44.0 | W | Low |
| 44.0 | W | Low |
| 44.0 | NW | Low |
| 45.0 | W | High |
| 45.0 | E | Low |
| 45.0 | E | Low |
| 45.0 | NE | Low |
| 45.0 | S | Moderate to High |

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| | | |
|------|----|-----------------|
| 46.0 | NE | Low |
| 46.0 | W | Low |
| 46.0 | SE | Low |
| 46.0 | W | Low |
| 46.0 | N | Low |
| 46.0 | S | Moderate |
| 47.0 | W | Low to Moderate |
| 48.0 | W | High |
| 48.0 | S | Low to Moderate |
| 49.0 | E | Low |
| 49.0 | S | Low |
| 50.0 | NW | High |
| 50.0 | NW | Low |
| 50.0 | E | Low to Moderate |

5. BGS Groundwater Flooding

5.1 Groundwater Flooding Susceptibility Areas

Are there any British Geological Survey groundwater flooding susceptibility flood areas within 50m of the boundary of the study site? **Yes**

What is the susceptibility to Groundwater Flooding in the search area based on the underlying geological conditions? **Potential for groundwater flooding at surface**

Does this relate to Clearwater Flooding or Superficial Deposits Flooding? **Superficial Deposits Flooding**

5.2 Groundwater Flooding Confidence Areas

What is the British Geological Survey confidence rating in this result? **Moderate**

Groundwater flooding is defined as the emergence of groundwater at the ground surface or the rising of groundwater into man-made ground under conditions where the normal range of groundwater levels is exceeded.

The **confidence rating** is on a threefold scale - Low, Moderate and High. This provides a relative indication of the BGS confidence in the accuracy of the susceptibility result for groundwater flooding. This is based on the amount and precision of the information used in the assessment. In areas with a relatively lower level of confidence the susceptibility result should be treated with more caution. In other areas with higher levels of confidence the susceptibility result can be used with more confidence.

6. BGS Geological Indicators of Flooding

6.1 Are there any geological indicators of flooding within 250m of the study site?

Yes

This dataset identifies the presence of superficial geological deposits which indicate that the site may be, or have been in the past, vulnerable to inland and/or coastal flooding. This assessment does not take account of any man-made factors such as flood protection schemes, and the data behind the report are purely geological.

| Distance [m] | Direction On Site | Description |
|--------------|----------------------|--|
| 0.0 | | Lower flood potential from rivers: areas affected by secondary flooding in extreme cases as a result of a prolonged flood event. |
| 50.0 | W | Lower flood potential from rivers: areas affected by secondary flooding in extreme cases as a result of a prolonged flood event. |



Flood Risk Assessment - Richmond upon Thames College Redevelopment

Flood Risk Assessment - Richmond upon Thames College Redevelopment

Prepared for

Cascade Consulting
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Report reference: 62335R3, June 2015
Report status: FINAL

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Flood Risk Assessment - Richmond upon Thames College Redevelopment

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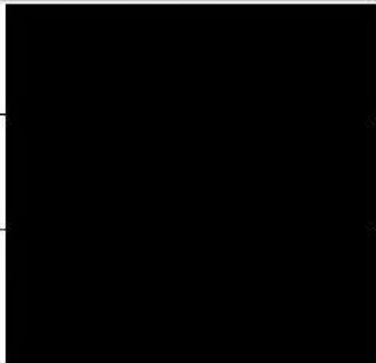
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62335R3. FINAL

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Revision record:

| Issue | Report ref | Comment | Author | Checker | Reviewer | Issue date | Issued to |
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| 4 | | | | | | | |

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1 INTRODUCTION

1.1 Background

Richmond upon Thames College is situated at National Grid reference TQ 15384 73787 (nearest postal code TW2 7SJ) in Twickenham adjacent to the south side of Chertsey Road, in south west London. It is proposed to redevelop the college building with new college buildings, a secondary school, a school for children with special needs, a Tech Hub, residential buildings and sports ground. The junction between Chertsey Road and Langhorn Drive is also a part of the development. The redevelopment project is known as Richmond Education and Enterprise Campus (REEC) project.

1.2 Scope of work

Cascade Ltd. instructed ESI Ltd. (ESI) in February 2014 to prepare a Flood Risk Assessment (FRA) in support of a planning application for the Site. ESI is an independent environmental consultancy which specialises in hydrogeological and hydrological assessment.

The scope of work included the preparation of the FRA, following the guidance of the National Planning Policy Framework (NPPF) (DCLG, 2012), to satisfy both the Environment Agency and the LPA that all potential flood risks to and from the proposed development have been considered. The site boundary is taken from the illustrative plan SK-160.

The London Borough of Richmond upon Thames (LBRuT) local authority has indicated that a robust assessment of flood risks must be undertaken. The Level 1 Strategic Flood Risk Assessment of LBRuT was consulted. Reference is also made to the LBRuT's Site Allocation Plan (2014) to help inform the results of sequential and exception tests of the Site.

The Environment Agency required in their scoping opinion that the FRA should address all potential sources of flooding from the Site. Wherever possible, all proposed buildings should lie outside the fluvial 1 in 100 year storm event, plus allowance for climate change impact. If this is not possible, flood plain compensation will be required. Where required, the applicant must demonstrate a safe route of access and egress for any building located near or in the fluvial 1 in 100 chance in any year, plus allowance for climate change impact.

1.1 Data sources

The information presented in the report is predominantly based on secondary data analysis associated with both the Site itself and the surrounding land area. The main sources of data are summarised below.

- GroundSure Flood Report, 2014 (Appendix A)
- Site Location Plan (Drawing SK-120) provided by Cascade Ltd (Appendix B);
- Illustrative Masterplan (Drawing SK-160) provided by Cascade Ltd (Appendix B);
- Site Building Zones Parameter Plan (Drawing SK-124) provided by Cascade Ltd (Appendix B);
- Topographical Survey (2008) undertaken by 3 Sixty Measures (Appendix B);
- Environment Agency Modelled Flood Levels and Maps (Product 4) (Appendix C);
- Thames Water Sewer Flooding Enquiry (Appendix D)
- Ordnance Survey mapping;
- Site-specific rainfall data from the CEH Flood Estimation Handbook (NERC, 2009);

- British Geological Survey mapping for desk study of geology and ground condition;
- Soil types and permeability data from the National Soil Research Institute (NSRI, 2014).

1.2 Report limitations

It is noted that the findings presented in the report are largely based on information supplied by third parties, therefore no guarantee can be offered as to its validity.

This report excludes consideration of potential hazards arising from any activities within the Site other than normal use and occupancy for the intended land uses. Hazards associated with any other activities have not been assessed and must be subject to a specific risk assessment by the parties responsible for those activities.

1.3 Risk assessment approach

An assessment of flood risk has been undertaken in accordance with the NPPF (DCLG, 2012) and following the technical guidance available in Environment Agency (2014). Flood risk to and from the Site has been assessed and potential mitigation measures have been outlined.

2 SITE DESCRIPTION

2.1 Site setting and surrounding area

The current use of the Site is a built up educational campus, with surrounding residential areas. The college is located between Chertsey Road and Craneford Way. The eastern and western boundary of the college is limited by Marsh Farm Lane and Egerton Road respectively. The College playing field is also part of the development site. The River Crane flows to the south of the playing field.

The REEC campus consists of approximately 9 ha of land. The topography is relatively flat with an average elevation between 8.5 mAOD to the south and 9.0 mAOD to the north (3 Sixty Measurement, 2008).

2.2 Current Development (Baseline Phase)

The northern section is occupied by a sports hall with associated facilities, a grass sports pitch, and a car park in the north east corner. The central section is occupied by a collection of buildings housing the College's academic and workshop facilities. The northern section and the central section are divided by a private road which joins Langhorn Drive and subsequently Chertsey Road which is the main vehicle access route. The College playing fields are bounded to the south by the River Crane, to the north by Craneford Way (a public road), and to the east by private housing (

Figure 2.1).

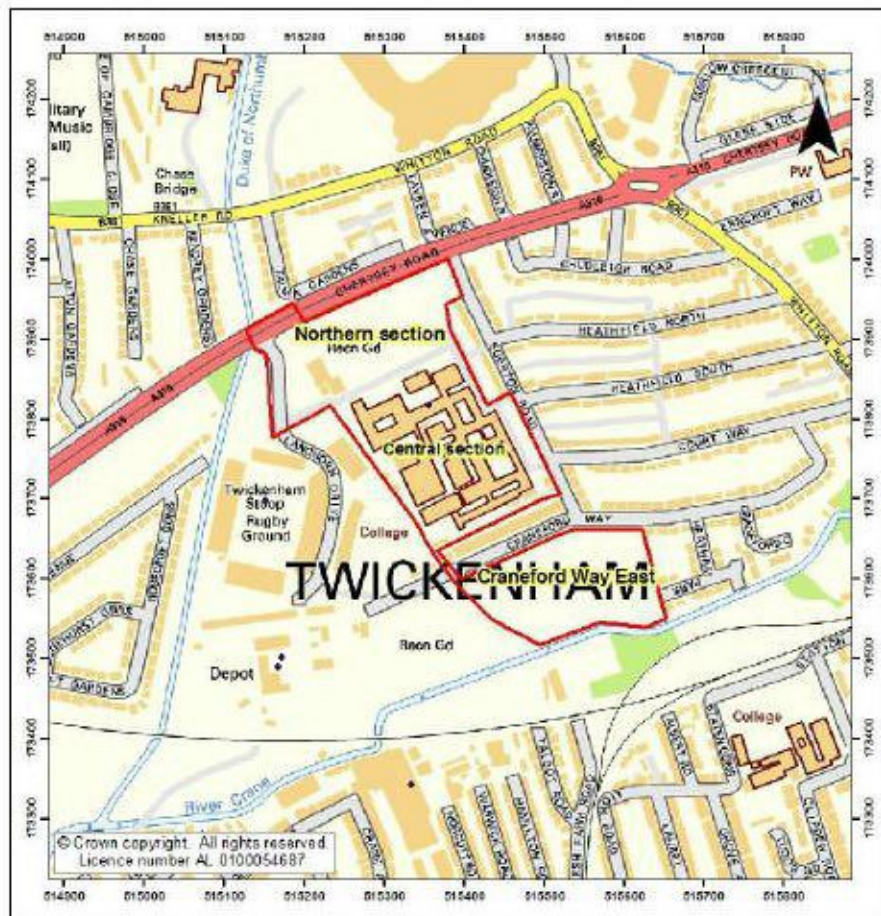


Figure 2.1 Location Plan

2.3 Proposed Development (Operational Phase)

The northern section will be redeveloped into new college buildings, a secondary school, a school for children with special needs, a Tech Hub, STEM centre and Sports centre. The road junction between Chertsey Road and Langhorn Drive will be modified to accommodate increased traffic after redevelopment.

The central section will be redeveloped into a residential area. The College playing fields to the south of Craneford Way will be improved with one all weather and one grass pitch. The Illustrative Masterplan for the Site is shown in Appendix B.

2.4 Geology

The underlying geology comprises London Clay (Clay and Silt). The superficial deposits comprise the Kempton Park Gravel Formation (sand and gravel).

2.5 Hydrology

2.5.1 Rainfall

The Standard Average Annual Rainfall (SAAR) at the Site is 602 mm based on data for the period 1961 -1990 (NERC, 2008).

2.5.2 Surface Water Features

The River Thames runs 1 km to the south east of the Site and is the main river the watercourses around the Site feed into. Existing watercourses are shown on the Site location map Figure 2.2. Adjacent to Craneford Way East on the south side, the River Crane runs in a man-made canal from west to east, before joining the River Thames further east at NGR TQ 16669 75383.

The Duke of Northumberland River is located west of the Site and flows from south to north towards the River Thames which is located c. 2 km to the east of the Site. It branches off from the River Crane 500 m south west of the Site and flows under Chertsey Road further downstream. A tributary to the River Crane appears at the ground surface, east of Twickenham stadium to the north east of the Site and flows west to east, to join the River Crane 1 km north east of the Site (Figure 2.2).

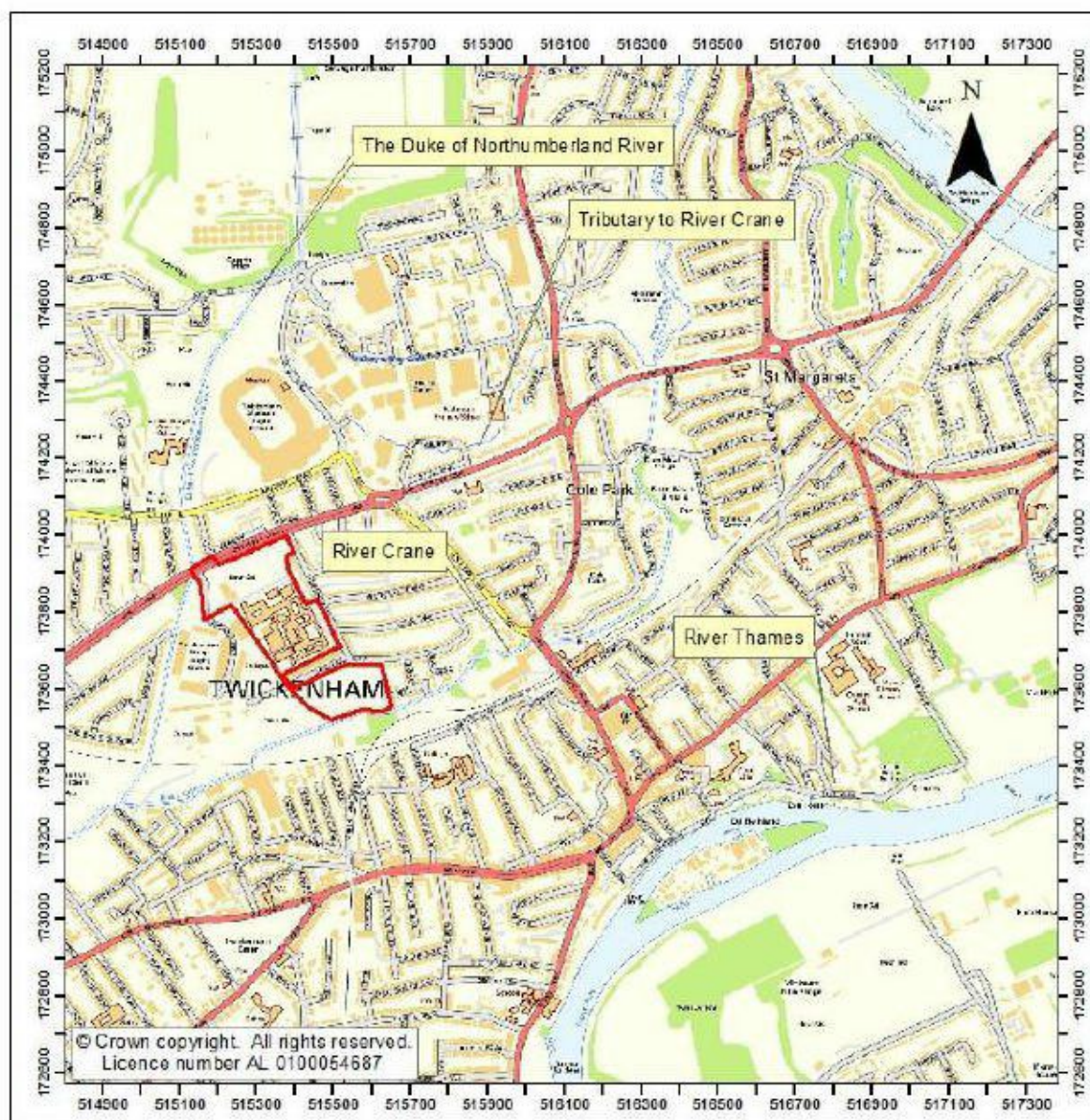


Figure 2.2 Existing Drainage Features

3 FLOOD RISK TO THE DEVELOPMENT SITE (BASELINE PHASE)

3.1 Historical Flooding

The River Thames has a considerable history of flooding with significant events (resulting in property flooding) occurring no less than nine times within the past 100 years (LBRuT, 2010). The most recent River Thames flood occurred in 2003 in which a number of areas to the west of London were severely affected, resulting in damage to homes and businesses within low lying Boroughs (including Spelthorne and Windsor & Maidenhead) along the Thames corridor. The River Crane catchment areas are much smaller than the Thames catchment, and they are subsequently 'flashier' systems that will respond to a rainfall event faster than the River Thames.

The Local Council is aware of localised flooding issues within 1.5 km of the Site at the following locations (LBRuT, 2010):

- Twickenham Bridge
- Twickenham dip
- Back gardens adjacent to the River Crane downstream of Chertsey Road

All of these events occurred further than 500m from the Site and no incidents have been reported on the Site itself. According to Groundsure (2014), no historical flooding has been recorded within 250m of the Site. However, the absence of data does not provide a definitive conclusion that the Site has never flooded, only that the Environment Agency hold no record of any flooding at the Site. Anecdotally, the Community Liaison Forum says that there has been flooding at the Site in the past.

3.2 River and Coastal Flooding

The majority of the Site (including the northern and central section) lies in Flood Zone 1 (Figure 3.1) which has lower than a 1 in 1000 year annual probability of flooding.

The southern half of the College playing field the south of Craneford Way is within Flood Zone 2 which has lower than a 1 in 100 year but higher than a 1 in 1000 year annual probability of flooding.

The SFRA (LBRuT, 2010) indicates that a large proportion of Twickenham, north of the railway line, is within Flood Zone 2 which has between a 1 in 100 and 1 in 1000 year probability of being affected by fluvial flooding from the River Crane and Duke of Northumberland's River.

There is a flood defence comprising a 1.5m high wall and lined channel on the River Crane south of the Site. The design standard of protection of the defence is 1 in 10 year. As the playing field south of Craneford Way is located on a relatively higher ground level to the flood defences, the chance of flooding is estimated to be less than 1 in 100 year based on the EA's flood indicative maps and the River Crane Mapping Study (Halcrow, 2008).

The Duke of Northumberland's River has bank protection on both sides. The design standard of protection is 200 years. The defences along the River Crane and the Duke of Northumberland's River are presented in Figure 3.2.

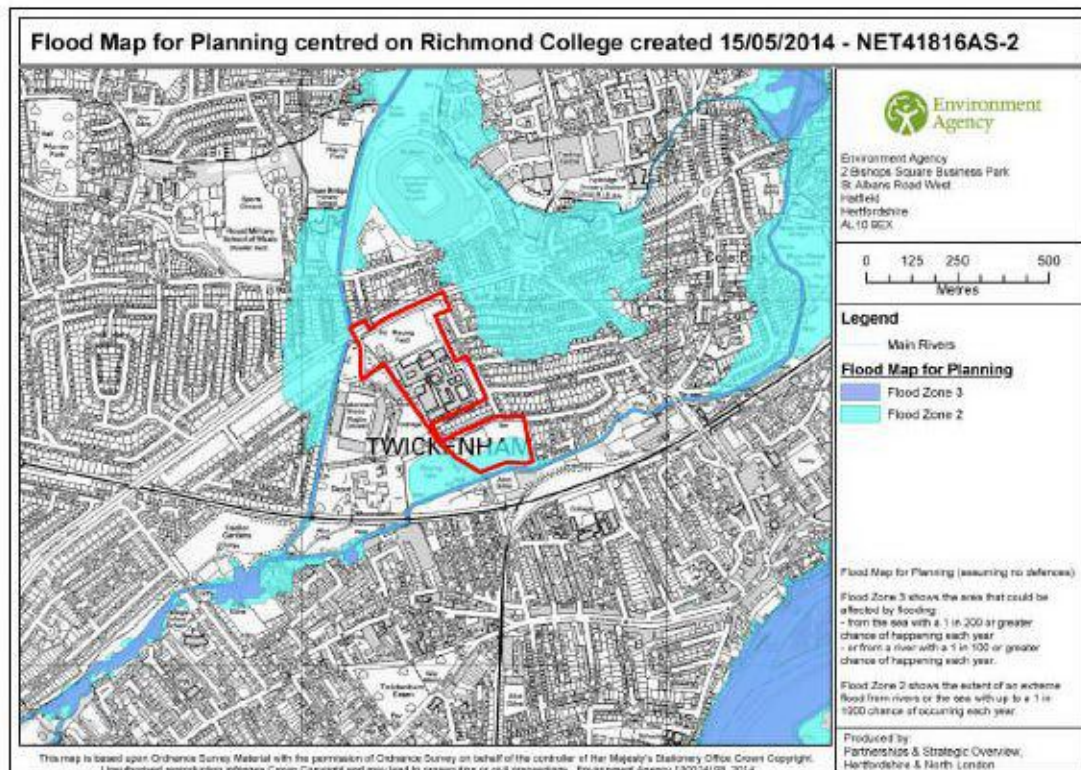


Figure 3.1 Environment Agency River and Coastal Flood Zone map (EA, 2014)

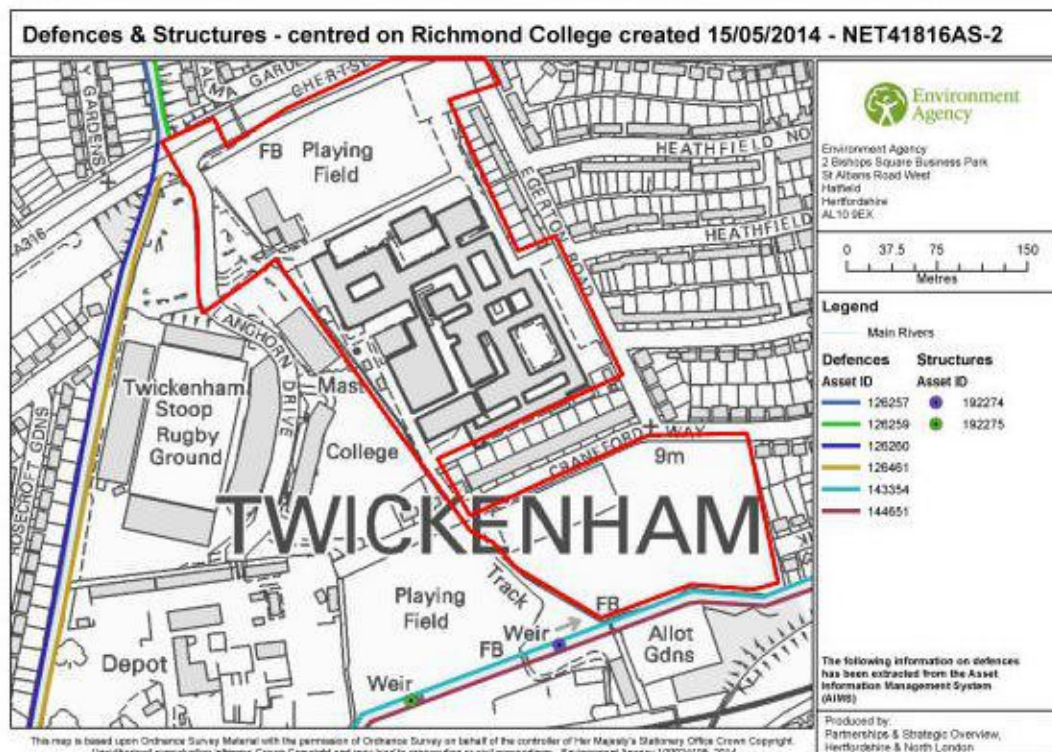


Figure 3.2 Flood defences

3.3 Surface Water Flooding

Surface water (pluvial) flooding is usually associated with extreme rainfall events but may also occur when rain falls on land that is already saturated or has a low permeability. In each case, the rainfall generates overland flow which can lead to flooding before the runoff is able to enter a sewer or watercourse. Overland flow can also generate 'ponding' in localised topographical depressions.

The risk of pluvial flooding has been assessed using results from the JBA surface water flooding map (Figure 3.3, taken from GroundSure, 2014) which shows a varied risk of pluvial flooding throughout the Site ranging from negligible to high.

The map shows some areas potentially at risk of surface water ponding for the modelled event. However JBA surface water modelling assumes a symbolic drainage and effectively maps overland flow over topography. JBA mapping is an indication that the risk of surface flooding may exist. A detailed modelling exercise will have to be undertaken to assess the real risk during the detailed design stage. Finished floor levels of REEC should be higher than the modelled surface water flood level.

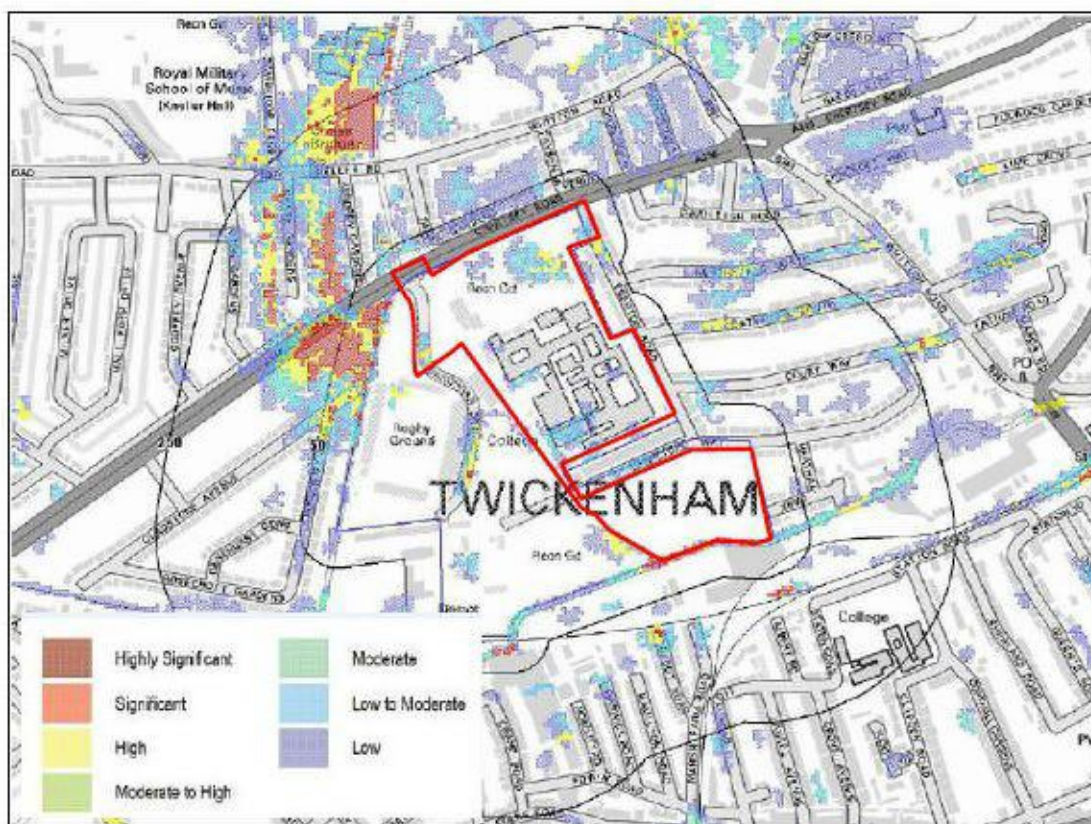


Figure 3.3 Surface Water flood map

The areas associated with the high pluvial flood risk are small and associated with small parts of the grass sports pitch in the northern section. This is believed to be caused by local depressions and locally impermeable soils. The remainder of the Site presents small patches of low to moderate pluvial risk associated with impermeable surfaces and poor drainage.

3.4 Groundwater Flooding

Groundwater flooding occurs when the water table rises above the ground surface. Geological mapping (www.bgs.co.uk) of this Site indicates that the bedrock geology

underlying the Site is the London Clay Formation which is not associated with groundwater flooding and has no aquifer designation. There are superficial deposits of Kempton Park Gravel Formation (sand and gravels) beneath the Site (BGS, 2014) and these are classified as a principal aquifer.

The British Geological Survey (BGS) susceptibility map identifies the Site as having "potential for groundwater flooding at surface" (GroundSure, 2014). However based on a risk assessment the site is considered at negligible risk of groundwater flooding according to the ESI groundwater flood risk map (ESI, 2014), for the 1 in 100 year event based on the map in Figure 3.4. Deep subterranean structures and basements would potentially be at risk of groundwater ingress. In relation to the groundwater flood risk, the ESI map is a National risk map (as used by LandMark) based on modelled groundwater levels and is our selected method for screening the Site. The other reports rely on a susceptibility to groundwater flooding, not risk and are considered to be overly conservative.

The sand and gravels below the Site are most likely in hydraulic continuity with the River Thames. The groundwater response, to a river flood event, could exceed the ground level in the vicinity of the river, even if river bank defences are not overtopped, however the impact is unlikely to extend beneath the main site.

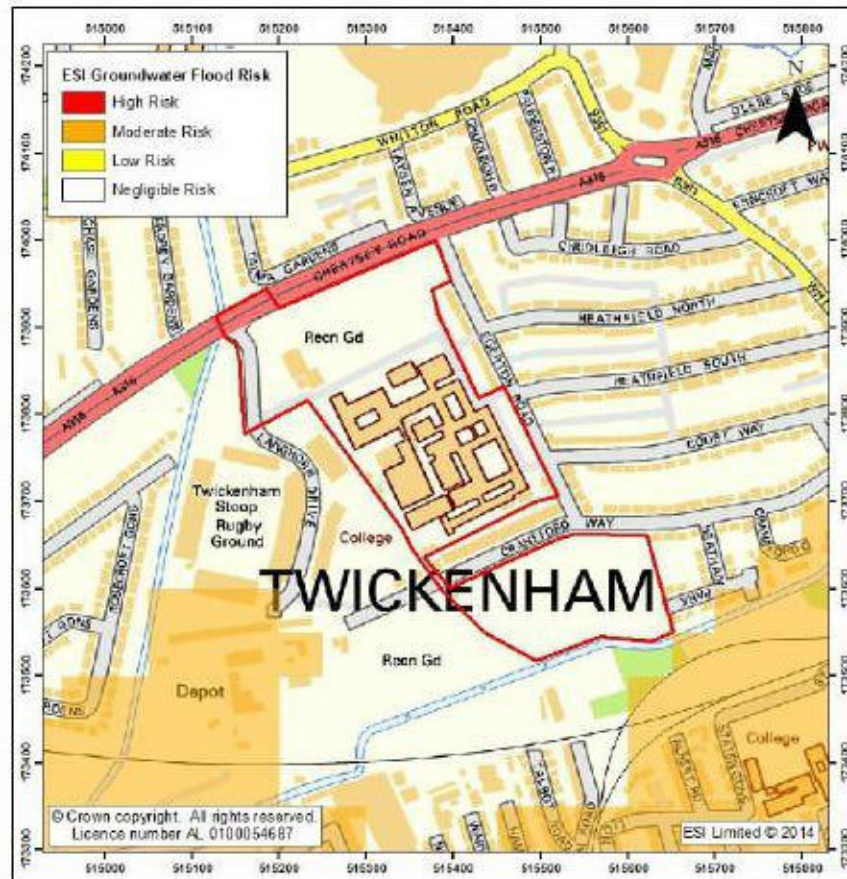


Figure 3.4 Groundwater Flood Risk Map (ESI, 2014)

3.5 Sewer Flooding

The flooding records held by Thames Water indicate that there have been no incidents of flooding in the area as a result of surcharging public sewers (Thames Water, 2014).

3.6 Modelled Flood Level with Climate Change

A part of the College playing field south of Craneford Way is submerged for the 1 in 1000 year fluvial flood event (Figure 3.5). The River Crane Mapping Study (Halcrow, 2008) modelled the River Crane and the Duke of Northumberland's River. The flood levels at the following node labels presented in Table 3.1 are adjacent to the College playing field.

Table 3.1 Modelled flood level in the River Crane

| Node label | Easting | Northing | 100 yr +CC |
|------------|---------|----------|------------|
| C526 | 515584 | 173537 | 8.413 |
| C527 | 515506 | 173513 | 8.575 |
| C528 | 515504 | 173513 | 8.568 |

All the proposed buildings are located to the northern section of the Site and are outside the 1 in 100 year plus climate change flood extent. Therefore this satisfies the Environment Agency's requirement that all proposed buildings should lie outside the fluvial 1 in 100 year storm event, plus allowance for climate change impact.

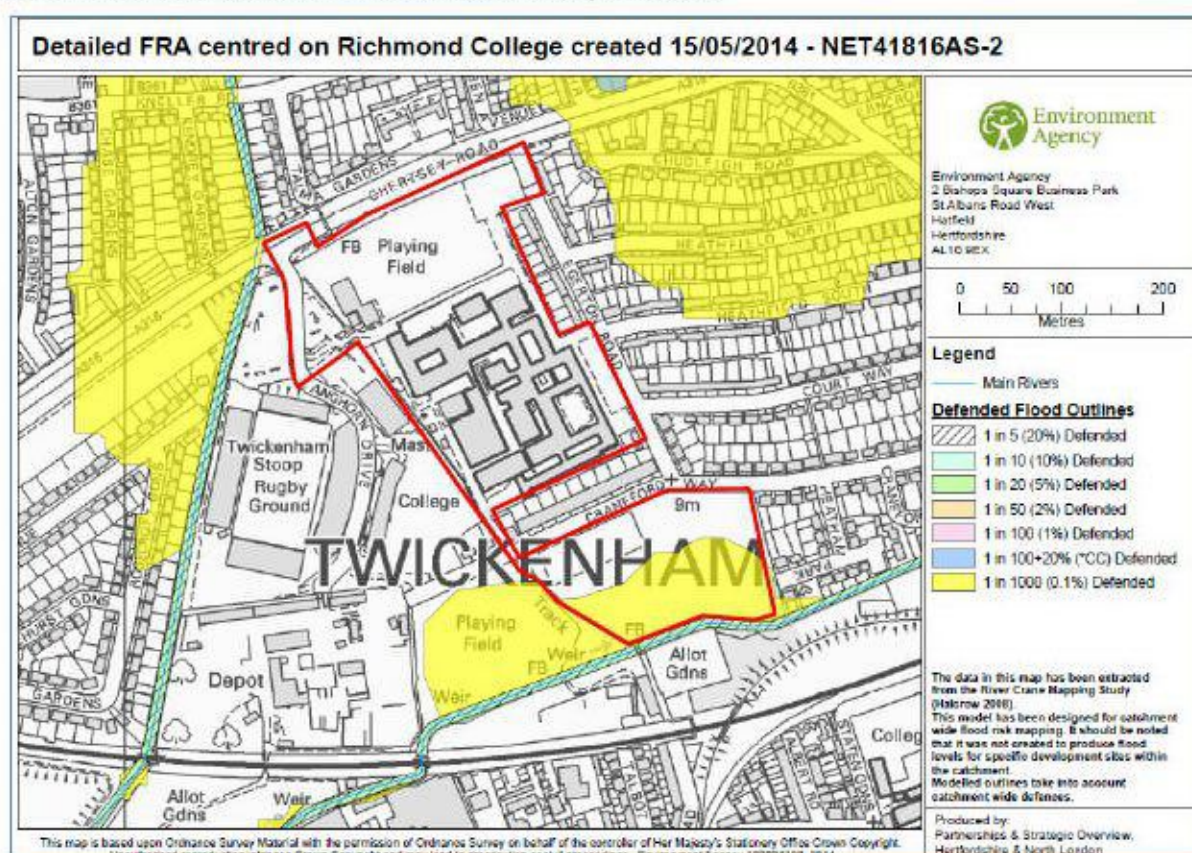


Figure 3.5 The EA Modelled Flood Outline for Different Return Periods

3.7 Geological Indicators of Past Flooding

Geological indicators of past flooding include superficial deposits which are susceptible to flooding, either from coastal inundation or fluvial (inland) water flow.

There are geological indicators of flooding within 250 m of the Site relating to the sand and gravel superficial deposits which are associated with riverine processes in the past 10,000 years (BGS, 2014).

3.8 Flooding in the Event of a Reservoir Failure

The Site is not located within an area identified as being at risk of flooding due to the event of a reservoir failure (Groundsure, 2014).

4 FLOOD RISK FROM THE DEVELOPMENT SITE

4.1 Flood Risk during Construction/Demolition Phase

Given the scale of the development, the current expectation is that the development construction programme would commence in 2016 in a phased manner over a 4 year period. For the purposes of the ES, the year of completion and full operation of the development is therefore considered to be 2019. Whilst full details regarding the demolition and construction works are not yet finalised, general information about the likely timing of activities, are described in the Environmental Statement (Cascade, 2015).

Flood risk during construction is likely to differ from the long term condition, as there will be changes in hardstanding on the Site. The construction area of each construction phase and runoff generated is outlined in the drainage assessment report (ESI, 2015). There will be no stockpiling of materials within the identified 100 year return period floodplain during the demolition and construction process.

A strategy to manage the surface water run-off during the construction phase is described in the drainage assessment report (ESI, 2015). Run-off with high loading of suspended solids should be prevented from leaving the Site and entering the surrounding water bodies. This would have a detrimental effect on the local ecology of the water bodies.

Sustainable Drainage System (SuDS) will be required for the development as part of the planning process. It is proposed to install these water management systems at an early stage in the construction process. Care should be taken to protect any SuDS features for long term operation and in particular from being compromised by demolition and construction activities. For example, locations identified for soakaways at conceptual/outline drainage design stage, should not be used as drive ways for lorries during demolition/construction as the loading from the lorries will alter the underlying soil structure and permeability.

In general, it is assumed that works will take place in accordance with standard best practice to prevent impact on water quality associated with any significant rainfall event.

The REEC development scheme will not have plant located below ground or basement or underground parking. Based on the available information at the outline/planning stage, it is reasonable to assume dewatering is not required. At detailed design stage, if the depth of foundation is greater than the maximum groundwater table, dewatering will be required. In that case, a detailed infiltration tests and ground condition is required to undertake estimation of dewatering volume during construction. Provisions should be made to manage this potential issue in line with standard industry practice for construction in saturated ground.

4.2 Flood Risk during Operational Phase

The development of a conceptual site drainage plan at an early stage is required to inform operation of the Site. A sustainable drainage strategy (ESI, 2015) has been developed for operational phase. The proposed drainage scheme assessed the existing drainage of the Site as well as the new SuDS techniques according to the DM SD 7 surface water drainage policy (LBRuT, 2011) and the London Plan. The surface run-off from the proposed development is estimated for return period of 1 in 10 year, 1 in 30 year and 1 in 100 year plus climate change rainfall event. A range of suitable drainage techniques are recommended (green roofs, permeable pavement, soakaways and flood storage area). In the operational phase, the Site is designed to manage surface runoff for a 1 in 100 years plus climate change rainfall event with no discharge to surface watercourses.

A site wide Utility Statement was undertaken by Atkins in May 2014 (Atkins, 2015). The report confirms presence of a soakaway system for draining the current site. The report also suggests a gravity connection to a combined Thames Water manhole MH 5703, serving the eastern portion of the site. However the connections are thought to be blocked and this assumption may need to be verified.

It has therefore been assumed that the current site is successfully drained by soakaway. It is possible that the current soakaways are not adequate to fully drain the Site in extreme rainfall conditions but there is no evidence of flooding occurring on the Site as a consequence, or of informal discharges from the Site into adjacent watercourses during extreme rainfall.

A similar system of soakaways with additional SuDS features should thus be sufficient to attenuate the runoff from the proposed development without a discharge to surface watercourses. Details are described in the sustainable drainage assessment report.

5 SUITABILITY OF THE PROPOSED DEVELOPMENT

5.1 Sequential Tests

Based on the classification of the NPPF, (DCLG, 2012), the proposed development falls into various flood risk vulnerability classifications (Table 2 of NPPF, (DCLG, 2012)). The residential, college and school buildings are classified as more vulnerable infrastructure. The Tech Hub is a less vulnerable and the College playing field is a water compatible infrastructure. The Sequential Test (DCLG, 2014) identifies that development should be directed to areas with the lowest probability of flooding. According to Site Allocation Plan (LBRuT, 2014), the development has passed the sequential test, however this was based on an old Site boundary different from the current one (Figure 5.1) which was solely in Flood Zone 1. The new Site has now been extended to include the College playing fields on Craneford Way East which is within Flood Zone 2. The Site would need to be reconsidered for a sequential test with the current Site boundary. The development on Craneford Way East would consist of outdoor sports and recreation facilities which is 'water compatible development' (Table 2 of NPPF (DCLG, 2014)) so the development is still expected to pass the sequential test.

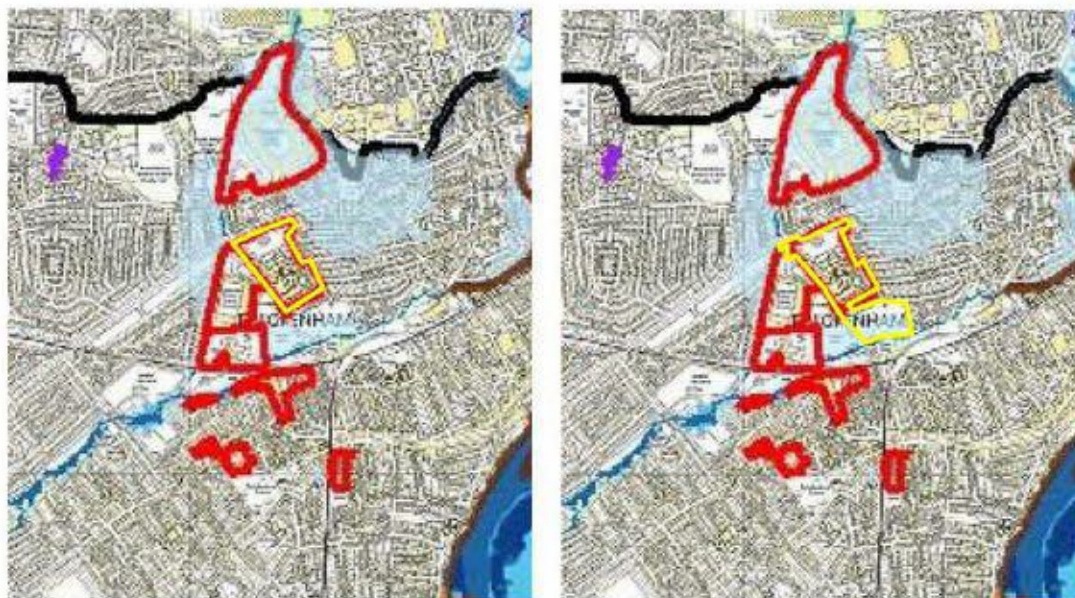


Figure 5.1 Comparison of the New Site Boundary (Right) with the Old Site Boundary (Left) (LBRuT, 2014)

5.2 Exception Test

Assuming the sequential test is passed the flood risk vulnerability and flood zone 'compatibility' guidance in Table 3 of NPPF (DCLG (2014)) indicates an exception test (see glossary) is not required and the development is considered to be appropriate for this Site (Table 5.1)

Table 5.1 Flood risk vulnerability and flood zone compatibility

| Flood risk vulnerability classification | | Essential infrastructure | Water compatible | Highly vulnerable | More vulnerable | Less vulnerable |
|--|-------------------------------|---------------------------------|-------------------------|--------------------------|-------------------------|------------------------|
| Flood Zone | Zone 1 | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Zone 2 | ✓ | ✓ | Exception Test required | ✓ | ✓ |
| | Zone 3a | Exception Test required | ✓ | x | Exception Test required | ✓ |
| | Zone 3b functional floodplain | Exception Test required | ✓ | x | x | x |

✓ Development is appropriate.

x Development should not be permitted.

Data source: National Planning Policy Framework (NPPF) Technical Guidance, 2014.

6 POTENTIAL MITIGATION

The flood mitigation measures would be considered for REEC for different phases as presented in Table 6.1 (baseline, construction and operation).

6.1 Safe Access and Egress

The Environment Agency states in their scoping opinion that wherever possible, all proposed buildings should lie outside the fluvial 1 in 100 year storm event, plus allowance for climate change flood extent. If this is not possible, flood plain compensation and demonstration of a safe route of access and egress will be required.

All the proposed buildings are located outside the 1 in 100 year plus climate change flood extent as discussed in section 3.6. The College playing field lies in Flood Zone 2. Since the site is not located and surrounded by the 1 in 100 year plus climate change flood extent, a flood plain compensation and safe route of access and egress plan is not required.

Though the College playing field lies in Flood Zone 2, it is considered a water compatible structure and will provide flood storage to attenuate excess runoff (ESI, 2015). Therefore it may provide additional flood storage benefit.

Table 6.1 Potential Receptors, Impact and Flood Mitigation Measures

| Potential Sensitive Receptors | Potential Impact | Potential Effect | | Potential Mitigation Measures |
|---|---|---|---|---|
| | | Scoped In (requires further considerat ion) | Scoped Out (requires no further consider ation) | |
| Rivers and ecology | Silty water (all phases) | ✓ | | SuDS features. |
| Basement/underground structures | Groundwater flooding (all phases) | | ✓ | N/A |
| Playing fields | Fluvial flooding (all phases) | ✓ | | No mitigation is required. |
| Entire Site | Sewer flooding | ✓ | | Extensive usage of SuDS to reduce future potential. |
| Entire Site | Reservoir flooding | | ✓ | N/A |
| Entire Site | Surface water flooding | ✓ | | Appropriate landscaping and use of SuDS |
| Off-site receptors | Flood risk from the proposed development | ✓ | | Design and implementation of a comprehensive SuDS drainage strategy. |
| Chertsey Road Junction (site entrance) | Fluvial flooding | | ✓ | N/A |
| Future operational soakaways SuDS components | Reduce soil infiltration capacity (construction and demolition) | ✓ | | Make sure heavy machinery is directed away from such receptors. |
| Site drainage and SuDS | Silty water (all phases) | ✓ | | Protect the SuDS from sedimentation. |

7 CONCLUSION

It is proposed to re-develop Richmond College in London to a new college building, a secondary school, a school for children with special needs, a Tech Hub and sports grounds, with enabling residential development. The junction connecting Chertsey Road and Langhorn Drive is also a part of the new development. The Site area is c. 9 ha and is currently used for educational purposes.

The majority of the Site, and the area where all new buildings will be located, lies in Flood Zone 1 which has less than 1 in 1000 year annual probability of flooding. A part of the College playing field to the south of the Site lies in Flood Zone 2 which has annual probability of flooding between 1 in 1000 and 1 in 100 year.

The site benefits from flood defences. There are formal defences on both bank of River Crane and The Duke of Northumberland's River.

The River Thames flows approximately 1 km to the south of the Site and it has a considerable history of flooding with significant events (resulting in property flooding) in 2003. However no historical flooding has been recorded within 250m of the Site.

The Site has low to high risk of surface water flooding in different areas according to the JBA surface water flooding map. Groundwater flood risk is negligible at the Site according to the ESI groundwater flood risk map.

Reference is made to the LBRuT's Site Allocation Plan (2014) to help inform the results of sequential and exception tests of the Site. The northern section of the proposed site has passed the sequential test as a part of LBRuT's Site Allocation Plan. The College playing field to the south of the development is a water compatible land use according to the NPPF (DCLG, 2014). Therefore no exception test would be required and the development is appropriate for this location, provided suitable mitigation measures are in place.

Flood risk to the potential receptors and suitable mitigation measures have been assessed. The flood risk from the proposed development during construction/demolition and operational phase has been assessed in a separate sustainable drainage assessment report (ESI, 2015). The report also presents surface runoff produced during a 1 in 100 year plus climate change event and drainage strategy to manage and attenuate the excess runoff without discharging to surface watercourses.

The Environment Agency's comments during scoping opinion have been addressed in the FRA. All proposed buildings lie outside the fluvial 1 in 100 year storm event, plus allowance for climate change impact. Therefore no flood plain compensation will be required and the requirement of a safe route of access and egress is not necessary for the proposed Site.

8 REFERENCES

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Environment Agency (29/07/14) Telephone communication with Joe Martin 02032638087

Thames Water (02/06/14) Telephone conversation with a member of staff

3 Sixty Measurement, 2008 Underground Service Survey report

APPENDICES

APPENDIX A

Groundsure flood report

| | |
|-------------------------|------------------------------|
| Report Reference: | CMAPS-CM-325206-28958-150514 |
| Your Reference: | 28958 |
| Report Date: | 15 May 2014 |
| Report Delivery Method: | Email - pdf |
| Client Email: | andy@centremaps.com |

GroundSure Floodview

Address: RICHMOND-UPON-THAMES COLLEGE, EGERTON ROAD, ST MARGARETS AND NORTH TWICKENHAM, TWICKENHAM, TW2 7SJ

Dear Sir/Madam,

Thank you for placing your order with CENTREMAPS. Please find enclosed the GroundSure Floodview report as requested.

If you need any further assistance, please do not hesitate to contact our helpline on 01886 832972 quoting the above CENTREMAPS reference number.

Yours faithfully,

CENTREMAPS

Enc.
GroundSure Floodview

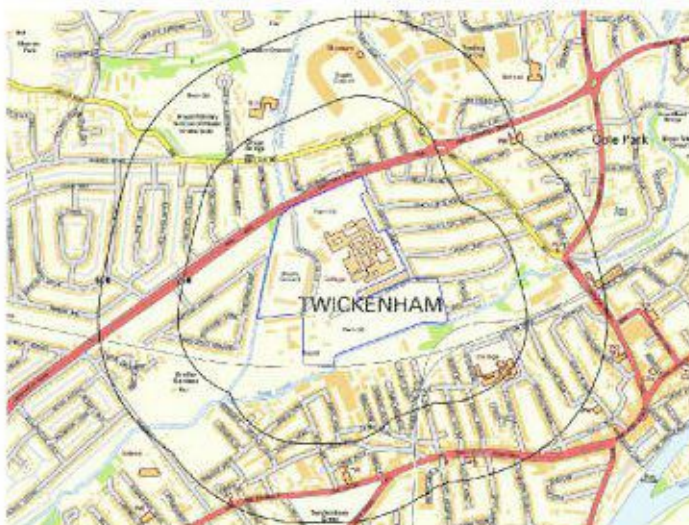
GroundSure Floodview

Address: RICHMOND-UPON-THAMES COLLEGE, EGERTON ROAD, ST MARGARETS AND NORTH
TWICKENHAM, TWICKENHAM, TW2 7SJ

Date: 15 May 2014

Your Reference: 28958

Client: CENTREMAPS



Aerial Photograph of Study Site



Aerial photography supplied by Getmapping PLC.
© Copyright: Getmapping PLC 2003. All Rights Reserved.

Site Name: RICHMOND-UPON-THAMES COLLEGE, EGERTON
ROAD, ST MARGARETS AND NORTH
TWICKENHAM, TWICKENHAM, TW2 7SJ

Grid Reference: 515351,173703

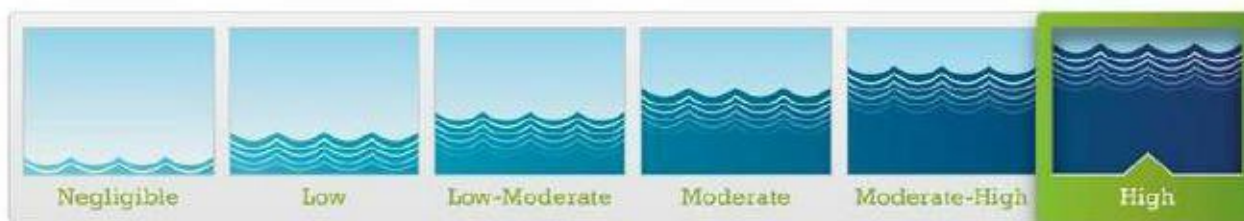
Size of Site: 19.42 ha

Report Reference: CMAPS-CM-325206-28958-150514

If you would like any further assistance regarding this report then please contact
CENTREMAPS on (T) 01886 832972, (F) 01883 833485, email: groundsure@centremaps.co.uk

Executive Summary: Flood Risk

The following opinion is provided by GroundSure on the basis of the information available at the time of writing and contained within this report.



| | |
|---|----------------------|
| Is insurance cover for flooding likely to be available for the property based upon Environment Agency NaFRA data? | May not be available |
| What is the highest NaFRA risk rating for the property? | High |
| What is the highest Environment Agency Flood Zone risk at the property? | High |
| What is the risk of flooding from pluvial/surface water sources? | Significant |
| If the site were to be redeveloped, would a NPPF flood risk assessment be required? | Yes |

Recommendations

It is recommended that several insurers are contacted to confirm the availability of reasonably priced insurance for the property.

The purchaser may wish to make specific enquiries of the vendor regarding the history of flooding at the property.

National Flood Risk Assessment (NaFRA)

As the site lies within or in close proximity to an area with a High risk rating in the NaFRA database, a prudent purchaser may wish to consider reducing the impact of flooding at the property by installing flood protection measures. Such measures may help reduce the effects of flooding at the property if flood defences are absent or are breached, and may assist in obtaining insurance for the site. Furthermore, it is recommended that anyone living within an

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area at High risk signs up to the Environment Agency's Flood Warning Scheme on 0845 988 1188 or at www.environment-agency.gov.uk.

Environment Agency Flood Zones

The site has been identified to lie within Flood Zone 3 as designated by the Environment Agency, indicating the site has a predicted chance of flooding of greater than 1.0% from fluvial sources or greater than 0.5% from coastal sources in any given year.

It is recommended that a purchaser consider reducing the impact of flooding at the property by installing flood protection measures. Such measures may help reduce the effects of flooding at the property if flood defences are absent or are breached, and may assist in obtaining insurance for the site. Further information on flood protection measures may be obtained from the National Flood Forum or the Flood Protection Association.

Groundwater Flooding

The BGS have identified potential for groundwater flooding at surface level in the area. This means that given the geological conditions in the vicinity groundwater flooding hazard should be considered in all land-use planning decisions. It is recommended that other relevant information e.g. records of previous incidence of groundwater flooding, rainfall, property type, and land drainage information be investigated in order to establish relative, but not absolute, risk of groundwater flooding.

Development Guidance

If the site is to be developed, a detailed Flood Risk Assessment will be required. 'Highly Vulnerable' developments, as defined within the National Planning Policy Framework (NPPF), will not be permitted within a Zone 3 floodplain, and 'Essential Infrastructure' and 'More Vulnerable' developments will be required to pass an Exemption Test prior to permission being granted. A GroundSure Flooding Desktop Report would assist in clarifying the flood risk to the property and assessing the potential for development at the site in relation to flood risk. GroundSure Flooding Desktop Reports are available from £500 + VAT. Please contact GroundSure for further details.

JBA Surface Water (Pluvial) Flooding

As the site lies within an area considered to be at Significant risk of surface water flooding (with a predicted depth of flooding of between 0.3m and 1m in a 1 in 75 year flooding event), it is recommended that a purchaser obtains a more detailed flood risk assessment. Some insurers may choose to not provide insurance cover for properties with a Significant risk of surface water flooding. The detailed flood risk assessment will further quantify the risk of flooding at the site as well as examining the history of flooding at the site, reviewing the standard of protection afforded to the site and providing a quote for a Full Flood Risk Assessment to meet the requirements of NPPF, if required. A GroundSure Flooding Desktop Report is available from GroundSure from £500 + VAT. Please contact GroundSure for further details.

Alternatively, a purchaser may wish to consider reducing the impact of flooding at the property by installing flood protection measures at the site. Such measures may help reduce the effects of flooding at the property if flood defences are absent or are breached, and may assist in obtaining insurance for the site. Further information on flood protection measures may be obtained from the National Flood Forum or the Flood Protection Association.

Historic Flood Events

Report Reference: [CMAPS-CM-325206-28958-150514](#)

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The site is not recorded to have been subject to historic flooding. However, the absence of data does not provide a definitive conclusion that the site has never flooded, only that the Environment Agency hold no record of any flooding at the site.

Additional Matters

| | |
|--------------------|--|
| Riparian ownership | If your land abuts a river, stream or ditch, you may have responsibility to maintain this watercourse, even if Title Deeds show the property boundary to be adjacent to the watercourse. This includes the responsibility for clearing debris and obstructions which may impede the free passage of water and fish, and also includes the responsibilities to accept flood flows through your land, even if these are caused by inadequate capacity downstream. There is no duty in common law for a landowner to improve the drainage capacity of a watercourse. Please contact GroundSure if you need further advice on riparian ownership issues relating to this property. |
| Sewerage Flooding | Extreme rainfall events may overwhelm sewerage systems and cause local flooding. The water and sewerage companies within the UK are required to maintain 'DG5 - At Risk Registers' which record properties that have flooded from sewers and/or are considered to be at risk of flooding from sewers in the future. If your property is on the 'At Risk' Register, this may be recorded within a standard CON29 Drainage and Water search. |

Overview of Findings

For further details on each dataset, please refer to each individual section in the main report as listed.

Report Section

1. Environment Agency Flood Zones

| | |
|--|-----|
| 1.1 Are there any Environment Agency Zone 2 floodplains within 250m of the study site? | Yes |
| 1.2 Are there any Environment Agency Zone 3 floodplains within 250m of the study site? | Yes |
| 1.3 Are there any Flood Defences within 250m of the study site? | No |
| 1.4 Are there any areas benefiting from Flood Defences within 250m of the study site? | No |
| 1.5 Are there any areas of Proposed Flood Defences within 250m of the study site? | No |
| 1.6 Are there any areas used for Flood Storage within 250m of the study site? | No |

2. National Flood Risk Assessment (NaFRA)

| | |
|---|------|
| 2.1 What is the National Flood Risk Assessment (NaFRA) Flood Rating for the study site? | High |
|---|------|

3. Historic Flood Events

| | |
|---|----|
| 3.1 Has the site been subject to past flooding as recorded by the Environment Agency? | No |
|---|----|

4. Surface Water Floods

| | |
|---|-----|
| 4.1 Is the site or any area within 50m at risk of Surface Water (Pluvial) Flooding? | Yes |
|---|-----|

5. Groundwater Flooding

| | |
|---|---|
| 5.1 What is the maximum BGS Groundwater Flooding susceptibility within 50m of the study site? | Potential for groundwater flooding at surface |
| 5.2 What is the BGS confidence rating for the Groundwater Flooding susceptibility areas? | Moderate |

6. BGS Geological Indicators of historic flooding

| | |
|---|-----|
| 6.1 Are there any geological indicators of historic flooding within 250m of the study site? | Yes |
|---|-----|

7. JBA Reservoir failure

| | |
|---|----|
| 7.1 Is the property located in an area identified as being at potential risk in the event of a reservoir failure? | No |
|---|----|

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If you would like any further assistance regarding this report then please contact CENTREMAPS on (T) 01886 832972, (F) 01883 833485, email: groundsure@centremaps.co.uk

Using this Report

The following report is designed by Environmental Consultants for commercial property transactions bringing together the most up-to-date market leading environmental data. This report is provided under and subject to the Terms & Conditions agreed between GroundSure and the Client.

Note: Maps

Only certain features are placed on the maps within the report. All features represented on maps found within this search are given an identification number. This number identifies the feature on the mapping and correlates it to the additional information provided below. This identification number precedes all other information and takes the following format -Id: 1, Id: 2, etc. Where numerous features on the same map are in such close proximity that the numbers would obscure each other a letter identifier is used instead to represent the features. (e.g. Three features which overlap may be given the identifier "A" on the map and would be identified separately as features 1A, 3A, 10A on the data tables provided).

Where a feature is reported in the data tables to a distance greater than the map area, it is noted in the data table as "Not Shown".

All distances given in this report are in Metres (m). Directions are given as compass headings such as N: North, E: East, NE: North East from the nearest point of the study site boundary.

Flood Risk Framework

The Flood Risk Assessment section is based on datasets covering a variety of different flooding types. No inspection of the property or of the surrounding area has been undertaken by GroundSure or the data providers. The modelling of flood hazards is extremely complex and in creating a national dataset certain assumptions have been made and all such datasets will have limitations. These datasets should be used to give an indication of relative flood risk rather than a definitive answer. Local actions and minor variations, such as blocked drains or streams etc. can greatly alter the effect of flooding. A low or negligible modelled flood risk does not guarantee that flooding will not occur. Nor will a high risk mean that flooding definitely will occur. GroundSure's overall flood risk assessment takes account of the cumulative risk as assessed within the Environment Agency's NaFRA and Flood Zone datasets, Historic Flood Events and surface water (pluvial) flooding.

This report provides an overall risk ranking of flooding potential at the site as well as answering the following key questions:

Is insurance likely to be available for the property?

A number of insurance companies providing cover for flood risk use this data as the basis of their risk model, although they may also utilise additional information such as claims histories, which may further influence their decision. Where a significant risk of flooding is identified flood risk insurance may be difficult to obtain without further work being undertaken. Property owners of sites within Low and Medium risk areas are still considered to be at risk of flooding and insurance premiums may be increased as a result. Owners of properties within Low, Medium and High risk areas are advised to sign up to the Environment Agency's Flood Warning scheme.

- Very Low – the chance of flooding from rivers or the sea is considered to be Less than 1 in 1000 (0.1%) chance in any given year.
- Low – the chance of flooding from rivers or the sea is considered to be less than 1 in 100 (1%) but greater than or equal to 1 in 1000 (0.1%) chance in any given year.
- Medium – the chance of flooding from rivers or the sea is considered to be less than 1 in 30 (3.3%) but greater than or equal to 1 in 100 (1%) chance in any given year.
- High – the chance of flooding from rivers or the sea is considered to be greater than or equal to 1 in 30 (3.3%) chance in any given year.

What is the Environment Agency NaFRA risk rating for the property?

This rating is based upon the highest NaFRA risk band to be found within the site boundary. See above for an explanation of NaFRA risk banding.

What is the highest Environment Agency Flood Zone risk at the site?

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The Environment Agency estimates the annual probability of flooding from rivers and the sea as:-

- Zone 1 – little or no risk with an annual probability of flooding from rivers and the sea of less than 0.1%.
- Zone 2 – low to medium risk with an annual probability of flooding of 0.1-1.0% from rivers and 0.1-0.5% from the sea.
- Zone 3 (or Zone 3a) – high risk with an annual probability of flooding of 1.0% or greater from rivers, and 0.5% or greater from the sea.
- Zone 3b – very high risk with the site being used as part of the functional flood plain or as a Flood Storage Area.

Where the property is in an area benefiting from flood defences these may be taken into account within the flood risk assessment provided. However it should be noted that flood defences do not entirely remove the risk of flooding, as they can fail or overtop. Owners of properties within Zone 2 and Zone 3 are advised to sign up to the Environment Agency's Flood Warning scheme.

What is the risk of flooding from pluvial/surface water sources?

JBA Risk Management surface water flood map identifies areas likely to flood following extreme rainfall events, i.e. land naturally vulnerable to surface water or "pluvial" flooding. This data set was produced by simulating 1 in 75 year, 1 in 200 year and 1 in 1000 year rainfall events. Modern urban drainage systems are typically built to cope with rainfall events between 1 in 20 and 1 in 30 years, though older ones may even flood in a 1 in 5 year rainstorm event.

The model provides the maximum depth of flooding in each 5m "cell" of topographical mapping coverage. The maps include 7 bands indicating areas of increasing natural vulnerability to surface water flooding. These are:-

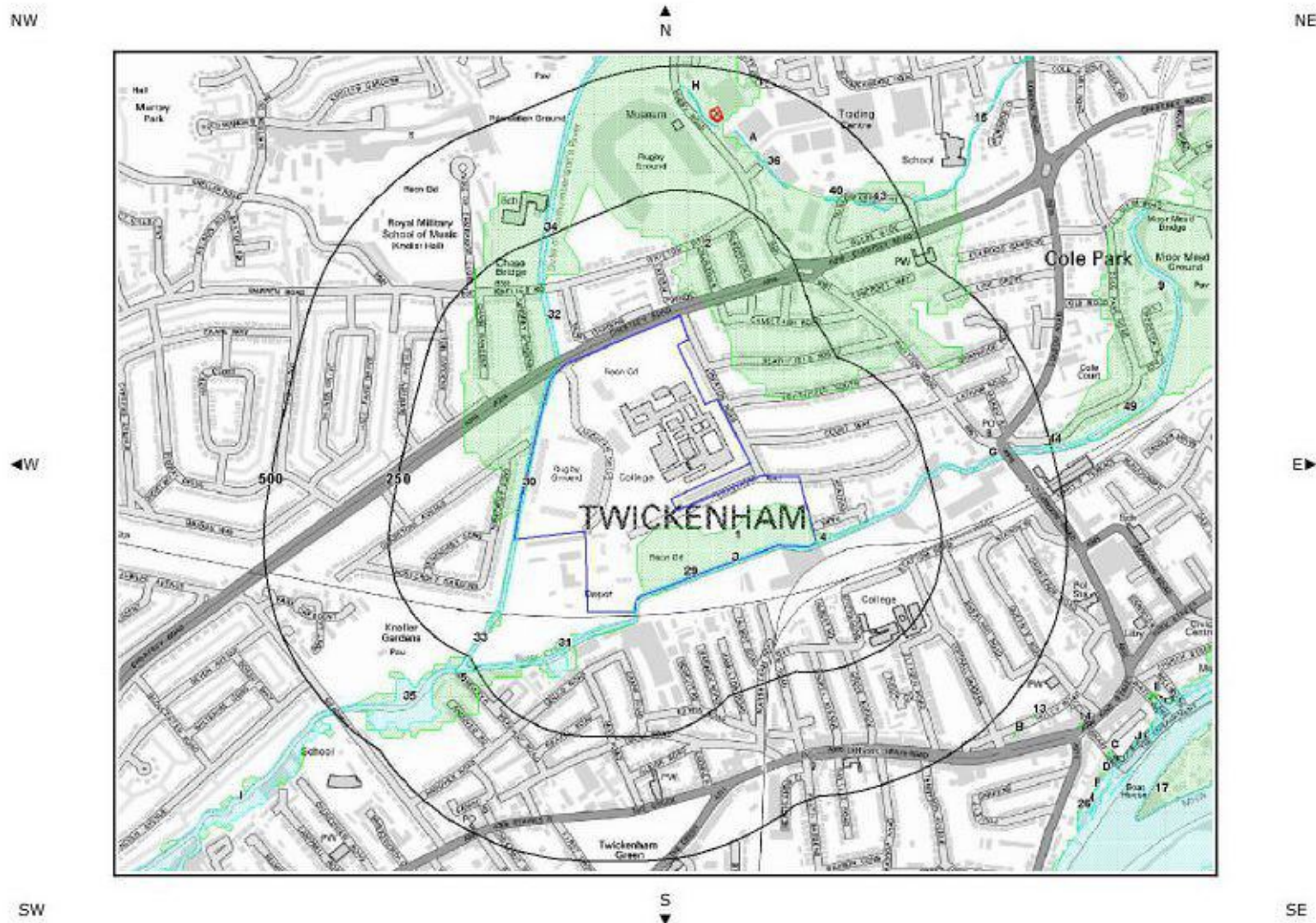
- 0.1m or greater in a 1 in 1,000 year rainfall event - Low
- Between 0.1m and 0.3m in a 1 in 200 year rainfall event – Low to Moderate
- Between 0.3m and 1.0m in a 1 in 200 year rainfall event - Moderate
- Greater than 1.0m in a 1 in 200 year rainfall event – Moderate to High
- Between 0.1m and 0.3m in a 1 in 75 year rainfall event - High
- Between 0.3m and 1.0m in a 1 in 75 year rainfall event – Significant
- Greater than 1.0m in a 1 in 75 year rainfall event – Highly Significant

If the site is to be redeveloped, will a Flood Risk Assessment be required under National Planning Policy Framework?

The *National Planning Policy Framework* identifies the need for Flood Risk Assessments to be carried out for developments within Flood Zones. Furthermore, any development proposals comprising one hectare or above will require a brief Flood Risk Assessment, partly due to their potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of new development on surface water run-off.

The Recommendations will also highlight whether the site has been subject to an historic flood event as recorded by the Environment Agency. Furthermore, the recommendations will indicate whether the site is considered to lie within an area which may be susceptible to groundwater flooding. However, information regarding groundwater flooding susceptibility is not used to calculate the overall flood risk to the property due to the limitations of the database. Additionally, the flood risk assessment does not take account of flooding from sources such as burst water mains, blocked sewers or appliance failure.

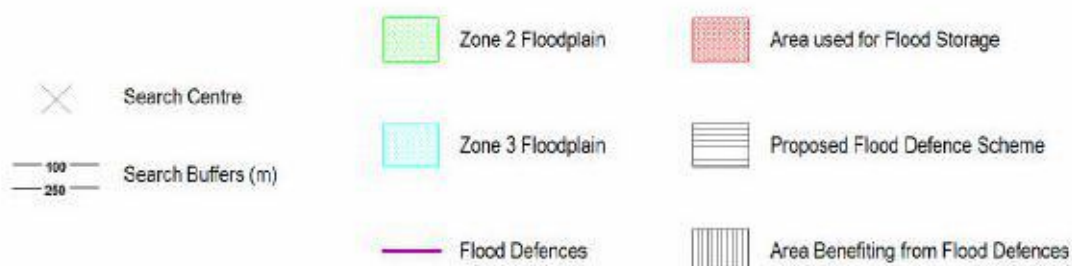
1. Environment Agency Flood Map for Planning (from rivers and the sea)



Environment Agency Flood Map for Planning Legend

Mapping sourced from
Ordnance Survey

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Report Reference: CMAPS-CM-325206-28958-150514

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1. Environment Agency Flood Zones

1.1 River and Coastal Zone 2 Flooding

Is the site within 250m of an Environment Agency Zone 2 floodplain?

Yes

Zone 2 floodplain estimates the annual probability of flooding as one in one thousand (0.1%) or greater from rivers and the sea but less than 1% from rivers or 0.5% from the sea. Any relevant data is represented on Map 1 – Flood Map for Planning:

The following floodplain records are represented as green shading on the Flood Map (1):

| ID | Distance [m] | Direction | Update | Type |
|----|--------------|-----------|-------------|----------------------------|
| 1 | 0.0 | On Site | 27-Feb-2014 | Zone 2 - (Fluvial Models) |
| 2 | 0.0 | On Site | 27-Feb-2014 | Zone 2 - (Fluvial Models) |
| 3 | 5.0 | S | 27-Feb-2014 | Zone 2 - (Fluvial Models) |
| 4 | 5.0 | SE | 27-Feb-2014 | Zone 2 - (Fluvial Models) |
| 5 | 8.0 | S | 27-Feb-2014 | Zone 2 - (Fluvial Models) |

1.2 River and Coastal Zone 3 Flooding

Is the site within 250m of an Environment Agency Zone 3 floodplain?

Yes

Zone 3 estimates the annual probability of flooding as one in one hundred (1%) or greater from rivers and a one in two hundred (0.5%) or greater from the sea. Any relevant data is represented on Map 1 – Flood Map for Planning.

The following floodplain records are represented as green shading on the Flood Map (1):

| ID | Distance [m] | Direction | Update | Type |
|----|--------------|-----------|-------------|----------------------------|
| 28 | 0.0 | On Site | 27-Feb-2014 | Zone 3 - (Fluvial Models) |
| 29 | 0.0 | On Site | 27-Feb-2014 | Zone 3 - (Fluvial Models) |
| 30 | 0.0 | On Site | 27-Feb-2014 | Zone 3 - (Fluvial Models) |
| 31 | 8.0 | S | 27-Feb-2014 | Zone 3 - (Fluvial Models) |
| 32 | 24.0 | NW | 27-Feb-2014 | Zone 3 - (Fluvial Models) |
| 33 | 151.0 | S | 27-Feb-2014 | Zone 3 - (Fluvial Models) |
| 34 | 166.0 | NW | 27-Feb-2014 | Zone 3 - (Fluvial Models) |

1.3 River and Coastal Flood Defences

Are there any Flood Defences within 250m of the study site ?

No

This search consists only of flood defences present in the dataset provided by the Environment Agency. Any relevant data is represented on Map 1 – Flood Map for Planning.

1.4 Areas benefiting from Flood Defences

Are there any areas benefiting from Flood Defences within 250m of the study site?

No

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Any relevant data is represented on Map 1 – Flood Map for Planning.

1.5 Proposed Flood Defences

Are there any Proposed Flood Defences within 250m of the study site?

No

Guidance: This search consists only of proposed flood defences present in the dataset provided by the Environment Agency. Please note that proposed flood defence schemes will not influence the current NaFRA ratings for the site.

Any relevant data is represented on Map 1 – Flood Map for Planning

This information is taken from the Environment Agency's database of Areas to Benefit from New and Reconditioned Flood Defences under the Medium Term Plan (MTP). The dataset contains funding allocation for the first financial year (from April). Funding for the following four financial years is not guaranteed, being only indicative, and will be reviewed annually. Projects within the Medium Term Plan qualify for inclusion in this dataset if:

- the investment leads to a change in the current standard of protection (change projects);
- the investment is a replacement or refurbishment in order to sustain the current the current standard of protection (sustain projects);
- the project has an initial construction budget of £100,000 or more; and
- the project is included within the first five years of the MTP

The data includes all the Environment Agency's projects over £100K that will change or sustain the standards of flood defence in England and Wales over the next 5 years. It also includes the equivalent schemes for all Local Authority and Internal Drainage Boards. The number of households and areas of land contributing to DEFRA's Outcome Measures (OM) are also attributed i.e. could benefit from major work on flood defences.

These data also contain Intermittence Flood Maintenance Programme that show the annual maintenance programme of work scheduled to be carried by the Environment Agency, Local Authority or Internal Drainage Board on flood defences. Data details routine maintenance as well as intermittent work that has been funded for the coming year. The data contains a start and end coordinate defining the relevant river section where work is planned.

Information Warning

Please note that the maps show the areas where investment is being made to reduce the flood and coastal erosion risk and are not detailed enough to account for individual addresses. Individual properties may not always face the same risk of flooding as the areas that surround them. Also, note that funding figures are indicative and any use or interpretation should account for future updates where annual values may change.

Every possible care is taken to ensure that the maps reflect all the data possessed by the Environment Agency and that they have applied their expert knowledge to create conclusions that are as reliable as possible. The Environment Agency consider that they have created the maps as well as they can and so should not be liable if the maps by their nature are not as accurate as might be desired or are misused or misunderstood, despite their warnings. For this reason, they are not able to promise that the maps will always be accurate or completely up to date.

This site includes mapping data licensed from Ordnance Survey used for setting the Environment Agency's data in its geographical context. Ordnance Survey retains the copyright of this material and it can not be used for any other purpose.

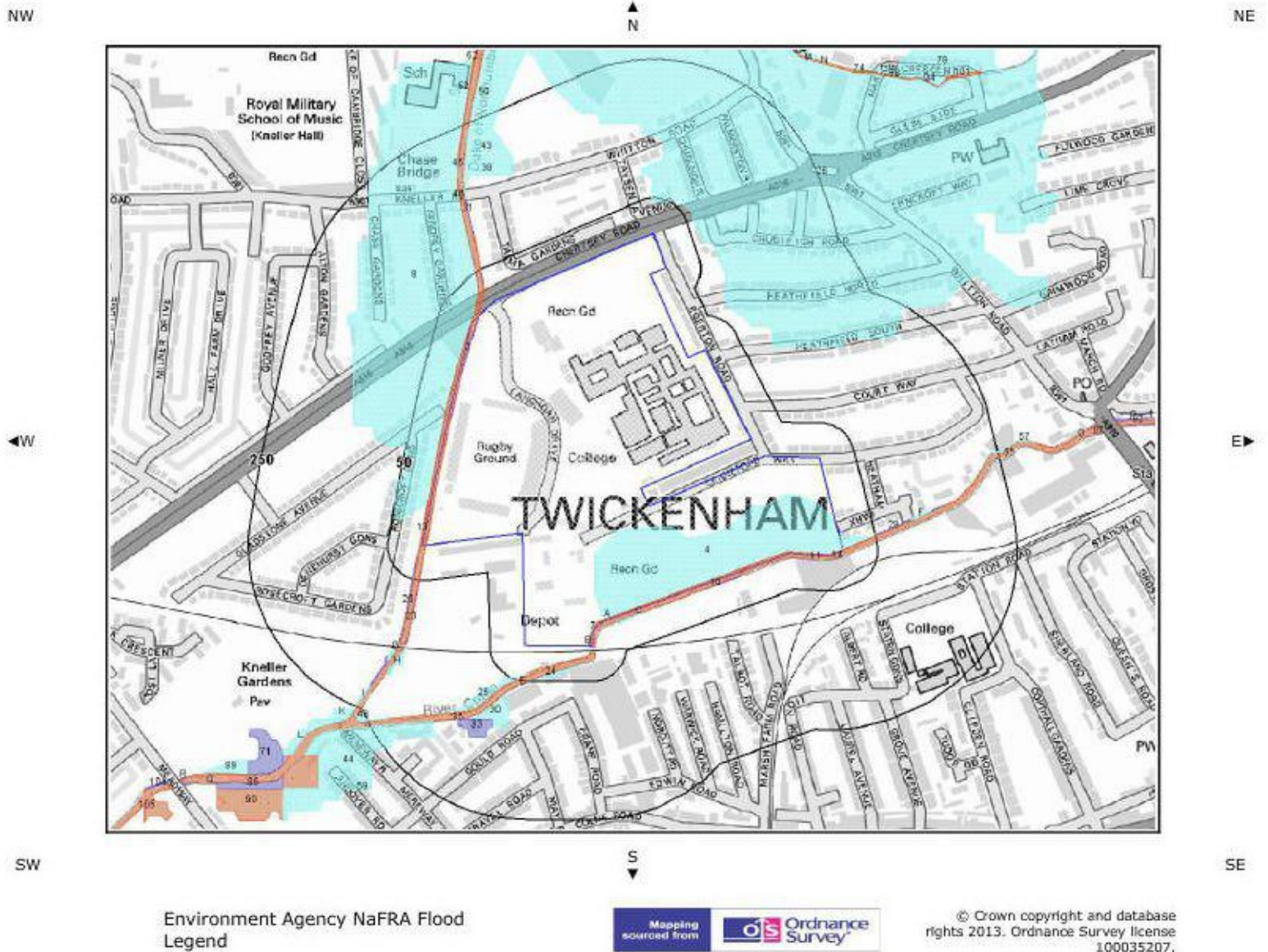
1.6 Areas used for Flood Storage

Are there any areas used for Flood Storage within 250m of the study site?

No

Flood Storage Areas are considered part of the functional floodplain, and are areas where water has to flow or be stored in times of flood. The National Planning Policy Framework states that only water-compatible development and essential infrastructure should be permitted within flood storage areas, and existing development within this area should be relocated to an area with a lower risk of flooding. Any relevant data is represented on Map 1 – Flood Map for Planning.

2. Environment Agency NaFRA Flooding Map



Site Outline

— 125 — Search Buffers (m)
— 250 —

NAFRA Rating

| | |
|--|----------|
| | Very Low |
| | Low |
| | Medium |
| | High |

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2.1 National Flood Risk Assessment (NaFRA) Flood Rating (River and Coastal)

What is the highest risk of flooding onsite?

High

The Environment Agency NaFRA database provides an indication of river and coastal flood risk at a national level on a 50m grid with the flood rating at the centre of the grid calculated and given above. The data considers the likelihood of flood defences overtopping or breaching by considering their location, type, condition and standard of protection.

A number of insurance companies providing cover for flood risk use this data as the basis of their risk model, although they may also utilise additional information such as claims histories, which may further influence their decision. Where a high risk of flooding is identified flood risk insurance may be difficult to obtain without further work being undertaken. Property owners of sites within Low and Medium risk areas are still considered to be at risk of flooding and insurance premiums may be increased as a result. Owners of properties within Low, Medium and High risk areas are advised to sign up to the Environment Agency's Flood Warning scheme.

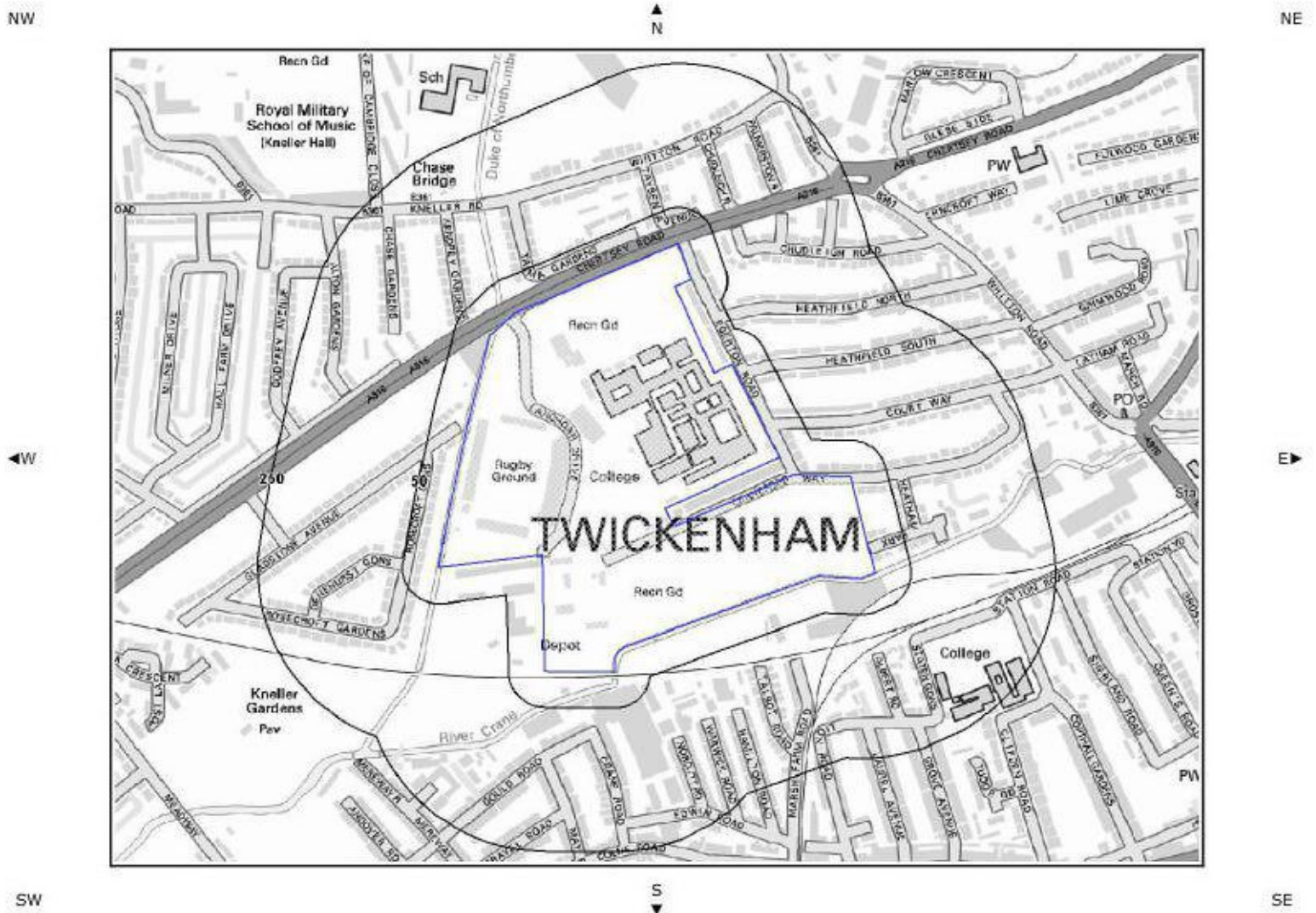
NaFRA data for the study site indicates the property is in an area with a High (1 in 30 or greater) chance of flooding in any given year.

Any relevant data within 250m is represented on Map 2- NaFRA Flooding:

Any data found within 50m of the site boundary is detailed below:

| ID | Distance [m] | Direction | NaFRA flood Risk |
|-----|--------------|-----------|------------------|
| 1 | 0.0 | On Site | High |
| 2 | 0.0 | On Site | Medium |
| 3 | 0.0 | On Site | High |
| 4 | 0.0 | On Site | Low |
| 5A | 0.0 | On Site | Low |
| 6B | 0.0 | On Site | Low |
| 7 | 0.0 | On Site | Low |
| 8 | 2.0 | W | Low |
| 9A | 4.0 | SE | Low |
| 10 | 4.0 | S | Medium |
| 11 | 4.0 | S | Medium |
| 12B | 4.0 | E | Low |
| 13 | 4.0 | W | Medium |
| 14 | 5.0 | SE | Medium |
| 15C | 5.0 | S | Low |
| 16C | 5.0 | S | Low |
| 17 | 8.0 | S | High |
| 18B | 9.0 | SE | Low |
| 19B | 9.0 | S | Low |
| 20 | 11.0 | SW | Medium |
| 21D | 14.0 | S | Low |
| 22D | 24.0 | S | Low |
| 23 | 29.0 | S | Medium |
| 24 | 32.0 | S | Low |
| 25 | 39.0 | S | Low |
| 26 | 45.0 | N | Low |

3. Environment Agency Historic Flooding Events



Environment Agency Historic Flooding
Legend

Mapping
sourced from
**Ordnance
Survey**

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-  Site Outline
-  Historic Flood Events
-  125 Search Buffers (m)
-  250 Search Buffers (m)

3.1 Historic Flood Outlines

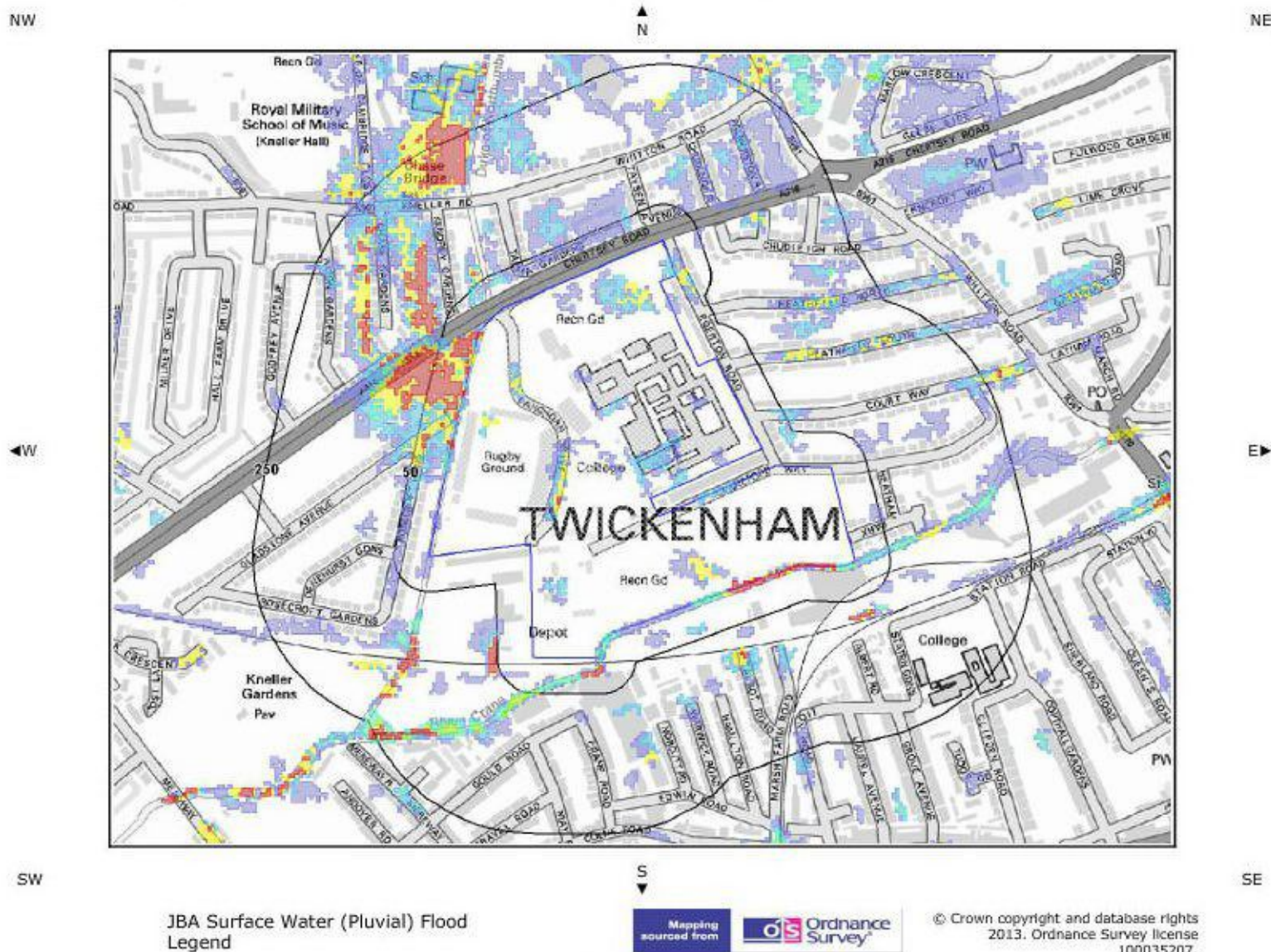
Has the site or any area within 250m of the site been subject to historic flooding as recorded by the Environment Agency? **No**

This database shows the individual footprint of every flood event recorded by the Environment Agency and previous bodies. This data is used to understand where flooding has occurred in the past and provides details as available. Absence of a historic flood event for an area does not mean that the area has never flooded, but only that the Environment Agency do not currently have records of flooding within the area. Equally, a record of a flood footprint in previous years does not mean that an area will flood again, and this information does not take account of flood management schemes and improved flood defences.

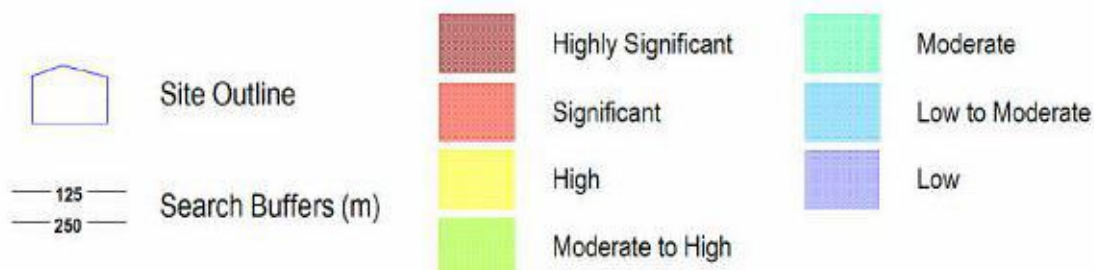
Any records found within the search radius are displayed on Map 3 – Historic Flooding Events.

Historic flooding events: Database searched and no data found.

4. JBA Surface Water (Pluvial) Flood Map



The data is provided by JBA Risk Management Limited, © Jeremy Benn Associates Limited and JBA Risk Management Limited 2008-2014.



Surface Water (pluvial) flooding is defined as flooding caused by rainfall-generated overland flow before the runoff enters a watercourse or sewer. In such events, sewerage and drainage systems and surface watercourses may be entirely overwhelmed.

What is the risk of pluvial flooding at the study site?

Significant

This data is provided by JBA Risk Management, © Jeremy Benn Associates Limited 2008-2014

The following pluvial (surface water) flood risk records within 50m of the study site are shown on the JBA Surface Water Flooding Map:

[illegible]

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| | | |
|------|---------|-----------------|
| 0.0 | On Site | Significant |
| 0.0 | On Site | Significant |
| 0.0 | On Site | Significant |
| 0.0 | On Site | Significant |
| 0.0 | W | Significant |
| 1.0 | S | High |
| 1.0 | S | High |
| 1.0 | W | High |
| 1.0 | S | Low |
| 1.0 | W | Low |
| 1.0 | S | Low to Moderate |
| 1.0 | S | Low to Moderate |
| 1.0 | W | Low to Moderate |
| 1.0 | E | Low to Moderate |
| 1.0 | W | Low to Moderate |
| 1.0 | W | Low to Moderate |
| 2.0 | S | Low |
| 2.0 | E | Low |
| 2.0 | SE | Low |
| 2.0 | S | Low |
| 2.0 | S | Low |
| 2.0 | W | Moderate |
| 3.0 | E | Low |
| 3.0 | S | Low to Moderate |
| 3.0 | W | Significant |
| 4.0 | E | High |
| 4.0 | SE | Low |
| 4.0 | W | Low to Moderate |
| 4.0 | W | Significant |
| 5.0 | S | High |
| 5.0 | S | Low |
| 6.0 | E | High |
| 6.0 | W | Low |
| 6.0 | SE | Low |
| 6.0 | W | Low |
| 6.0 | W | Low to Moderate |
| 6.0 | W | Low to Moderate |
| 7.0 | E | Low to Moderate |
| 8.0 | S | Low |
| 8.0 | W | Low |
| 8.0 | W | Low to Moderate |
| 9.0 | E | Low |
| 10.0 | W | High |
| 10.0 | W | High |
| 10.0 | S | High |
| 10.0 | W | Low to Moderate |
| 10.0 | W | Moderate |
| 10.0 | S | Significant |
| 13.0 | W | High |
| 13.0 | S | Low |
| 13.0 | E | Low |
| 13.0 | W | Low to Moderate |
| 13.0 | W | Moderate |
| 14.0 | W | Low |
| 15.0 | S | Low |
| 15.0 | S | Low to Moderate |
| 16.0 | E | Low to Moderate |
| 16.0 | W | Moderate |
| 16.0 | W | Significant |
| 17.0 | E | Low |
| 17.0 | W | Significant |
| 18.0 | W | Low |
| 18.0 | S | Low |
| 18.0 | W | Low to Moderate |
| 19.0 | W | High |
| 19.0 | SE | Low |
| 19.0 | W | Low to Moderate |
| 20.0 | S | High |
| 20.0 | W | Low |
| 20.0 | S | Low to Moderate |
| 20.0 | W | Significant |
| 20.0 | S | Significant |
| 21.0 | W | High |
| 21.0 | S | Low |
| 22.0 | N | Low |
| 22.0 | S | Low |
| 23.0 | SE | Low to Moderate |
| 23.0 | E | Moderate |
| 24.0 | E | Low |

| | | |
|------|----|------------------|
| 24.0 | W | Low to Moderate |
| 25.0 | S | Low |
| 25.0 | W | Low to Moderate |
| 25.0 | S | Moderate |
| 26.0 | SE | High |
| 26.0 | W | High |
| 26.0 | NE | Low |
| 26.0 | S | Low |
| 26.0 | W | Low |
| 26.0 | N | Low |
| 26.0 | SE | Low to Moderate |
| 27.0 | E | Low |
| 27.0 | W | Low |
| 27.0 | S | Low to Moderate |
| 28.0 | E | Low to Moderate |
| 28.0 | W | Low to Moderate |
| 29.0 | NW | Low |
| 29.0 | W | Low to Moderate |
| 29.0 | NW | Low to Moderate |
| 29.0 | W | Low to Moderate |
| 30.0 | NW | Low |
| 30.0 | S | Low |
| 30.0 | NW | Low |
| 31.0 | NW | Low |
| 31.0 | NE | Low to Moderate |
| 31.0 | N | Low to Moderate |
| 31.0 | NW | Low to Moderate |
| 32.0 | NW | Low |
| 32.0 | W | Low |
| 32.0 | W | Low |
| 32.0 | NW | Low |
| 32.0 | W | Low |
| 32.0 | W | Low to Moderate |
| 32.0 | N | Moderate |
| 33.0 | W | High |
| 33.0 | W | High |
| 33.0 | NW | Low |
| 33.0 | W | Significant |
| 34.0 | W | Low to Moderate |
| 35.0 | W | Low |
| 35.0 | S | Low |
| 35.0 | S | Low |
| 35.0 | S | Low |
| 35.0 | E | Low |
| 35.0 | S | Low to Moderate |
| 35.0 | S | Moderate |
| 35.0 | W | Significant |
| 36.0 | S | Low |
| 36.0 | NW | Low |
| 36.0 | NW | Low to Moderate |
| 36.0 | NE | Low to Moderate |
| 37.0 | W | High |
| 37.0 | W | Low |
| 37.0 | S | Low |
| 37.0 | W | Moderate |
| 38.0 | E | Low |
| 38.0 | NE | Low |
| 38.0 | E | Low |
| 39.0 | W | High |
| 39.0 | NW | Low |
| 40.0 | NE | Low |
| 40.0 | S | Low |
| 40.0 | W | Low |
| 40.0 | NW | Low |
| 40.0 | S | Moderate |
| 41.0 | W | Low |
| 43.0 | NW | Low |
| 43.0 | NE | Low |
| 43.0 | NW | Low to Moderate |
| 43.0 | NW | Moderate |
| 44.0 | NW | High |
| 44.0 | W | Low |
| 44.0 | W | Low |
| 44.0 | NW | Low |
| 45.0 | W | High |
| 45.0 | E | Low |
| 45.0 | E | Low |
| 45.0 | NE | Low |
| 45.0 | S | Moderate to High |

| | | |
|------|----|-----------------|
| 46.0 | NE | Low |
| 46.0 | W | Low |
| 46.0 | SE | Low |
| 46.0 | W | Low |
| 46.0 | N | Low |
| 46.0 | S | Moderate |
| 47.0 | W | Low to Moderate |
| 48.0 | W | High |
| 48.0 | S | Low to Moderate |
| 49.0 | E | Low |
| 49.0 | S | Low |
| 50.0 | NW | High |
| 50.0 | NW | Low |
| 50.0 | E | Low to Moderate |

5. BGS Groundwater Flooding

5.1 Groundwater Flooding Susceptibility Areas

Are there any British Geological Survey groundwater flooding susceptibility flood areas within 50m of the boundary of the study site? **Yes**

What is the susceptibility to Groundwater Flooding in the search area based on the underlying geological conditions? **Potential for groundwater flooding at surface**

Does this relate to Clearwater Flooding or Superficial Deposits Flooding? **Superficial Deposits Flooding**

5.2 Groundwater Flooding Confidence Areas

What is the British Geological Survey confidence rating in this result? **Moderate**

Groundwater flooding is defined as the emergence of groundwater at the ground surface or the rising of groundwater into man-made ground under conditions where the normal range of groundwater levels is exceeded.

The **confidence rating** is on a threefold scale - Low, Moderate and High. This provides a relative indication of the BGS confidence in the accuracy of the susceptibility result for groundwater flooding. This is based on the amount and precision of the information used in the assessment. In areas with a relatively lower level of confidence the susceptibility result should be treated with more caution. In other areas with higher levels of confidence the susceptibility result can be used with more confidence.

6. BGS Geological Indicators of Flooding

6.1 Are there any geological indicators of flooding within 250m of the study site?

Yes

This dataset identifies the presence of superficial geological deposits which indicate that the site may be, or have been in the past, vulnerable to inland and/or coastal flooding. This assessment does not take account of any man-made factors such as flood protection schemes, and the data behind the report are purely geological.

| Distance [m] | Direction | Description |
|--------------|-----------|--|
| 0.0 | On Site | Lower flood potential from rivers: areas affected by secondary flooding in extreme cases as a result of a prolonged flood event. |
| 50.0 | W | Lower flood potential from rivers: areas affected by secondary flooding in extreme cases as a result of a prolonged flood event. |